

DEPARTMENT OF ACADEMIC UPGRADING

COURSE OUTLINE – Fall 2023

SC 0100 (A2): Science and Society – 5 (5-0-0) 75 Hours for 15 Weeks

Northwestern Polytechnic acknowledges that our campuses are located on Treaty 8 territory, the ancestral and present-day home to many diverse First Nations, Metis, and Inuit people. We are grateful to work, live and learn on the traditional territory of Duncan's First Nation, Horse Lake First Nation and Sturgeon Lake Cree Nation, who are the original caretakers of this land.

We acknowledge the history of this land and we are thankful for the opportunity to walk together in friendship, where we will encourage and promote positive change for present and future generations.

INSTRUCTOR: Melissa Gajewski
OFFICE: J223
OFFICE HOURS: By appointment

PHONE: Office: 780-539-2023
E-MAIL: mgajewski@nwpolytech.ca

CALENDAR DESCRIPTION: This course is meant to increase the pre-high school student's understanding of connections between science, technology and society. You will be introduced to basic ideas about science, technology, biology, chemistry, physics, ecology, scientific method, along with related social issues.

PREREQUISITE(S)/COREQUISITE:

MA0081 or MA0091 placement test
Corequisites: EN0090

REQUIRED TEXT/RESOURCE MATERIALS:

10 quad to 1 cm graph paper (can be printed from myClass)
Nonprogrammable calculator (a TI-30XIIS is a good choice for this and future courses)
Printer

DELIVERY MODE(S):

Lecture style presentation of material followed by practice problems/discussion.
Laboratory provides hands-on experience.

LEARNING OUTCOMES:

Students will:

Unit A: Biological Diversity

- investigate and interpret diversity among species and within species, and describe how diversity contributes to species survival
- investigate the nature of reproductive processes and their role in transmitting species characteristics
- describe, in general terms, the role of genetic materials in the continuity and variation of species characteristics; and investigate and interpret related technologies
- identify impacts of human action on species survival and variation within species, and analyze related issues for personal and public decision making

Unit B: Environmental Chemistry

- investigate and describe, in general terms, the role of different substances in the environment in supporting or harming humans and other living things
- identify processes for measuring the quantity of different substances in the environment and for monitoring air and water quality
- analyze and evaluate mechanisms affecting the distribution of potentially harmful substances within an environment

Unit C: Electrical Principles and Technologies

- investigate and interpret the use of devices to convert various forms of energy to electrical energy, and electrical energy to other forms of energy
- describe technologies for transfer and control of electrical energy
- identify and estimate energy inputs and outputs for example devices and systems, and evaluate the efficiency of energy conversions
- describe and discuss the societal and environmental implications of the use of electrical energy

Unit D: Space Exploration (if time permits)

- investigate and describe ways that human understanding of Earth and space has depended on technological development
- identify problems in developing technologies for space exploration, describe technologies developed for life in space, and explain the scientific principles involved
- describe and interpret the science of optical and radio telescopes, space probes and remote sensing technologies
- identify issues and opportunities arising from the application of space technology, identify alternatives involved, and analyze implications

Note: We will NOT be covering Unit E Matter and Chemical Change because those topics are covered again, in much greater detail, in SC0110.

TRANSFERABILITY:

Please consult the Alberta Transfer Guide for more information. You may check to ensure the transferability of this course at the Alberta Transfer Guide main page

<http://www.transferalberta.alberta.ca>.

** Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions.
Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability

EVALUATIONS: Course final grade will be based on the following components.

Unit Tests (equal weighting)	45%	
Labs	10%	Late penalty 20% per day for up to 2 days.
Assignments, Quizzes	15%	Late penalty 20% per day for up to 2 days.
Final Exam (Cumulative)	30%	

All tests and exams **MUST** be written at the scheduled times unless **PRIOR** arrangements have been made with the instructor. A missed test (exam) will result in a score of **ZERO** on that test (exam). Only in very specific cases may student be given an opportunity to make up a missed exam (student will be presented with a different version of the exam). Doctor, lawyer or police documentation may be required. The final exam is 3 hours long and is scheduled by the registrars' office during NWP Exam weeks. Do not book vacation in this time period.

- Attendance is compulsory in all labs.
- Missed labs result in a score of zero. There are **NO** make-up labs.
- If you are late and have missed the lab safety discussion, you may be excluded from participating in the lab and will receive a mark of zero.
- Lab reports are due one week after the lab has been completed at the start of that day's class. Late lab reports will result in a penalty of 20% per day. Labs over two days late will not be graded without **PRIOR** approval.
- Download the lab sheets and complete the Pre-lab assignment, if required, before the lab period, data tables are completed during the lab and analysis and questions after the lab.

A LATE ASSIGNMENT WILL NOT BE ACCEPTED FOR MARKS ONCE THE ASSIGNMENT HAS BEEN RETURNED TO THE OTHER STUDENTS. You may still submit it and I will mark it (so that you have feedback on how well you understood the concepts) but the mark **WILL NOT** count towards your grade.

GRADING CRITERIA:

Please note that most universities will not accept your course for transfer credit **IF** your grade is **less than C-**.

Alpha Grade	4-point Equivalent	Percentage Guidelines	Alpha Grade	4-point Equivalent	Percentage Guidelines
A+	4.0	95-100	C+	2.3	67-69
A	4.0	85-94	C	2.0	63-66
A-	3.7	80-84	C-	1.7	60-62
B+	3.3	77-79	D+	1.3	55-59
B	3.0	73-76	D	1.0	50-54
B-	2.7	70-72	F	0.0	00-49

COURSE SCHEDULE/TENTATIVE TIMELINE: A Course Schedule is provided on myClass. Please print it off and keep a copy to refer to as it will contain a day-by-day breakdown of the topics we will be covering each day, the readings in the textbook, workbook questions, lab schedule, due dates and exam dates that you will be held to, whether or not those dates are referred to during class time.

STUDENT RESPONSIBILITIES: Refer to the Polytechnic's Policy on Student Rights and Responsibilities at <https://www.nwpolytech.ca/about/administration/policies/fetch.php?ID=69>. The Academic Upgrading Department is an adult education environment. Students are expected to show respect for each other as well as faculty and staff. Students are expected to participate fully in achieving their educational goals.

Certain activities are disruptive and not conducive to an atmosphere of learning. In addition to the *Student Rights and Responsibilities* as set out in the Polytechnic's calendar, the following guidelines will maintain an effective learning environment for everyone. We ask the cooperation of all students in the following areas of classroom deportment.

1. Attendance: Regular attendance and class participation is expected of all students and is crucial to good performance in the course. Class interruption due to habitual late arrival or leaving early will not be permitted. You may be debarred from the final exam if your absences exceed 15% of class days (10 lecture classes).
2. Check myClass as well as NWP email on a regular basis. Any changes to the Course Schedule or Exam Dates will be communicated on myClass. Students will be held to the deadlines listed on the Course Schedule whether or not those deadlines are spoken about in class.
3. Once in class – remain in class. Leaving to get a coffee is disruptive for others.
4. Assignments must be submitted on time.
5. Exams must be written on the days announced in class.
6. If an emergency prevents attendance on an exam day, students must contact me before the end of the exam (as soon as possible) via phone or email and may be asked to provide documentation to justify their absence.
7. No unspecified electronic devices will be permitted during exams.
8. Complete daily homework. At least **1.5 hours** of study per day outside of class time is required.
9. Behaviors that interfere with learning are not acceptable.
10. Take responsibility for your learning.
11. Communicate all requests regarding appointments, etc via email.

STATEMENT ON ACADEMIC MISCONDUCT:

Academic Misconduct will not be tolerated. For a more precise definition of academic misconduct and its consequences, refer to the Student Rights and Responsibilities policy available at <https://www.nwpolytech.ca/about/administration/policies/index.html>.

Additional Information:

Detailed Course Outline and Learning Objectives

Unit A: Biological Diversity

Key Concepts

- biological diversity
- habitat diversity
- species
- niches
- diversity within species
- populations

- asexual and sexual reproduction
- inheritance
- chromosomes, genes and DNA (introductory treatment)
- cell division—including binary fission and formation of sex cells
- natural and artificial selection of genetic characteristics

Students will:

1. Investigate and interpret diversity among species and within species, and describe how diversity contributes to species survival
 - observe variation in living things, and describe examples of variation among species and within species (*e.g., observe and describe characteristics that distinguish two closely related species*)
 - identify examples of niches, and describe the role of variation in enabling closely related living things to survive in the same ecosystem (*e.g., investigate different bird species found in a local park ecosystem, and infer how each is adapted to life within that ecosystem*)
 - investigate and interpret dependencies among species that link the survival of one species to the survival of others
 - identify examples of symbiotic relationships (*e.g., organisms that benefit other organisms by providing habitat, food, means of fertilization, or a source of oxygen*)
 - classify symbiotic relationships as mutualism, commensalism, parasitism
 - identify the role of variation in species survival under changing environmental conditions (*e.g., resistance to disease, ability to survive in severe environments*)
2. Investigate the nature of reproductive processes and their role in transmitting species characteristics
 - distinguish between sexual and asexual reproduction, and identify and interpret examples of asexual and sexual reproduction in different species, by:
 - describing mechanisms of asexual reproduction including binary fission, budding and the production of spores
 - describing mechanisms of sexual reproduction (*e.g., cross-fertilization in seed plants, sexual reproduction in mammals*)
 - describing examples of organisms that show both sexual and asexual reproduction (*e.g., yeasts that reproduce both by budding and sexual reproduction; plants that reproduce through suckering, runners or bulbs, as well as by seed production*)
 - describing the formation of zygote and embryo in plant and animal reproduction
 - describe examples of variation of characteristics within a species, and identify examples of both discrete and continuous variation (*e.g., hand clasping preference is an example of a discrete variation, the length of human hands varies on a continuum*)
 - investigate the transmission of characteristics from parents to offspring, and identify examples of characteristics in offspring that are:
 - the same as the characteristics of both parents
 - the same as the characteristics of one parent
 - intermediate between parent characteristics
 - different from both parents
 - distinguish those characteristics that are heritable from those that are not heritable, and identify characteristics for which heredity and environment may both play a role (*e.g., recognize that eye colour is heritable but that scars are not; recognize that a person's height and weight may be largely determined by heredity but that diet may also play a role*)
 - identify examples of dominant and recessive characteristics and recognize that dominance and recessiveness provide only a partial explanation for the variation of characteristics in

- offspring
3. Describe, in general terms, the role of genetic materials in the continuity and variation of species characteristics; and investigate and interpret related technologies
 - describe, in general terms, the role and relationship of chromosomes, genes and DNA
 - distinguish between cell division that leads to identical daughter cells, as in binary fission and mitosis, and cell division that leads to formation of sex cells, as in meiosis; and describe, in general terms, the synthesis of genetic materials that takes place during fertilization [*Note: At this level, students should understand that the formation of sex cells involves the halving of the parent cell's genetic materials and that this process leads to zygote formation. Opportunity for further study of the specific stages of cell division will be provided in senior high school courses (e.g., prophase, metaphase, anaphase, telophase).*]
 - compare sexual and asexual reproduction, in terms of the advantages and disadvantages (e.g., *recognize that asexual reproduction provides an efficient means of transmitting characteristics and that sexual reproduction provides an opportunity for recombination of characteristics*)
 - distinguish between, and identify examples of, natural and artificial selection (e.g., *evolution of beak shapes in birds, development of high milk production in dairy cows*)
 - describe, in simple terms, some genetic technologies (e.g., *cloning and genetic engineering*); and identify questions and issues related to their application
 4. Identify impacts of human action on species survival and variation within species, and analyze related issues for personal and public decision making
 - describe the relative abundance of species on Earth and in different environments (e.g., *note the overall abundance of insect species; note that in harsh environments there are relatively fewer species found than in temperate and tropical environments*)
 - describe ongoing changes in biological diversity through extinction and extirpation of native species, and investigate the role of environmental factors in causing these changes (e.g., *investigate the effect of changing river characteristics on the variety of species living in the river; investigate the effect of changing land use on the survival of wolf or grizzly bear populations*)
 - evaluate the success and limitations of various local and global strategies for minimizing loss of species diversity (e.g., *breeding of endangered populations in zoos, development of seed banks, designating protected areas, development of international treaties regulating trade of protected species and animal parts*)
 - investigate and describe the use of biotechnology in environmental, agricultural or forest management; and identify potential impacts and issues (e.g., *investigate issues related to the development of patented crop varieties and varieties that require extensive chemical treatments; identify issues related to selective breeding in game farming and in the rearing of fish stocks*)

Unit B: Environmental Chemistry

Key Concepts

- | | |
|--|--|
| • Workplace Hazardous Materials Information System (WHMIS) and safety | • chemicals essential to life |
| • substrates and nutrients | • air and water quality |
| • organic and inorganic material | • acids and bases |
| • ingestion and absorption of materials | • concentration and dispersal |
| • evidence of toxicity | • stability and biodegradability |
| • uncertainties in environmental monitoring and in assessing toxicity and risk | • hazards, probabilities and risk assessment |

Students will:

1. Investigate and describe, in general terms, the role of different substances in the environment in supporting or harming humans and other living things
 - identify common organic and inorganic substances that are essential to the health and growth of humans and other living things, and illustrate the roles served by these substances (*e.g., identify calcium as an essential material for bones; identify minerals that are known to enhance plant growth but that limit growth if too little or too much is available*)
 - describe, in general terms, the forms of organic matter synthesized by plants and animals, including carbohydrates, proteins and lipids
 - describe and illustrate processes by which chemicals are introduced to the environment or their concentrations are changed (*e.g., dilution in streams, biomagnification through food chains*)
 - describe the uptake of materials by living things through ingestion or absorption, and investigate and describe evidence that some materials are difficult for organisms to break down or eliminate (*e.g., DDT, mercury*)
 - identify questions that may need to be addressed in deciding what substances—in what amounts—can be safely released into the environment (*e.g., identify questions and considerations that may be important in determining how much phosphate can be released into river water without significant harm to living things*)
2. Identify processes for measuring the quantity of different substances in the environment and for monitoring air and water quality
 - identify substrates and nutrient sources for living things within a variety of environments
 - describe and illustrate the use of biological monitoring as one method for determining environmental quality (*e.g., assess water quality, by observing the relative abundance of various vertebrate and invertebrate species*)
 - identify chemical factors in an environment that might affect the health and distribution of living things in that environment (*e.g., available oxygen, pH, dissolved nutrients in soil*)
 - apply and interpret measures of chemical concentration in parts per million, billion or trillion
 - identify acids, bases and neutral substances, based on measures of their pH (*e.g., use indicator solutions or pH meters to measure the pH of water samples*)
 - investigate, safely, and describe the effects of acids and bases on each other and on other substances (*e.g., investigate and describe the reaction that results when baking powder is dissolved; describe the role of acids and bases in neutralizing each other*)
 - describe effects of acids and bases on living things (*e.g., acid rain in lakes, antacids for upset stomachs, pH in shampoos and conditioners*)
3. Analyze and evaluate mechanisms affecting the distribution of potentially harmful substances within an environment
 - describe mechanisms for the transfer of materials through air, water and soil; and identify factors that may accelerate or retard distribution (*e.g., wind speed, soil porosity*)
 - describe mechanisms for biodegradation, and interpret information on the biodegradability of different materials
 - comprehend information on the biological impacts of hazardous chemicals on local and global environments, by:
 - interpreting evidence for environmental changes in the vicinity of a substance release
 - interpreting LD50 data and other information on toxicity [*Note: LD50 refers to the amount of a substance found to be lethal to 50% of a population, if ingested.*]
 - identifying concerns with the disposal of domestic wastes, such as paints and oils, and industrial wastes

- describe and evaluate methods used to transport, store and dispose of hazardous household chemicals
- investigate and evaluate potential risks resulting from consumer practices and industrial processes, and identify processes used in providing information and setting standards to manage these risks (*e.g., interpret and explain the significance of manufacturer's information on how wood preservatives can be safely applied; recognize that some individuals may have greater sensitivity to particular chemical substances than do others in the general population*)
- identify and evaluate information and evidence related to an issue in which environmental chemistry plays a major role (*e.g., evaluate evidence that the use of insecticides to control mosquitoes has an effect/has no effect on bird populations*)

Unit C: Electrical Principles and Technologies

Key Concepts

- | | | |
|-------------------------------------|---|---------------------------------------|
| • forms of energy | • energy transformation | • generation of electrical energy |
| • electric charge and current | • circuits | • electrical energy storage |
| • energy transmission | • measures and units of electrical energy | • electrical resistance and Ohm's law |
| • renewable and nonrenewable energy | | |

Students will:

1. Investigate and interpret the use of devices to convert various forms of energy to electrical energy, and electrical energy to other forms of energy
 - identify, describe and interpret examples of mechanical, chemical, thermal, electrical and light energy
 - investigate and describe evidence of energy transfer and transformation (*e.g., mechanical energy transformed into electrical energy, electrical energy transferred through power grids, chemical energy converted to electrical energy and then to light energy in a flashlight, thermal energy converted to electrical energy in a thermocouple*)
 - investigate and evaluate the use of different electrodes, electrolytes and electrolytic concentrations in designing electrical storage cells
 - construct, use and evaluate devices for transforming mechanical energy into electrical energy and for transforming electrical energy into mechanical energy
 - modify the design of an electrical device, and observe and evaluate resulting changes (*e.g., investigate the effect of changes in the orientation and placement of magnets, commutator and armature in a St. Louis motor or in a personally-built model of a motor*)
2. Describe technologies for transfer and control of electrical energy
 - assess the potential danger of electrical devices, by referring to the voltage and current rating (amperage) of the devices; and distinguish between safe and unsafe activities
 - distinguish between static and current electricity, and identify example evidence of each
 - identify electrical conductors and insulators, and compare the resistance of different materials to electric flow (*e.g., compare the resistance of copper wire and nickel-chromium/Nichrome wire; investigate the conduction of electricity through different solutions; investigate applications of electrical resistance in polygraph or lie detector tests*)

- use switches and resistors to control electrical flow, and predict the effects of these and other devices in given applications (*e.g., investigate and describe the operation of a rheostat*)
 - describe, using models, the nature of electrical current; and explain the relationship among current, resistance and voltage (*e.g., use a hydro-flow model to explain current, resistance and voltage*)
 - measure voltages and amperages in circuits (*e.g., determine the resistance in a circuit with a dry cell and miniature light; determine the resistances of copper, nickel-chromium/ Nichrome wire, pencil graphite and salt solution*)
- apply Ohm’s law to calculate resistance, voltage and current in simple circuits
- develop, test and troubleshoot circuit designs for a variety of specific purposes, based on low voltage circuits (*e.g., develop and test a device that is activated by a photoelectric cell; develop a model hoist that will lift a load to a given level, then stop and release its load; test and evaluate the use of series and parallel circuits for wiring a set of lights*)
 - investigate toys, models and household appliances; and draw circuit diagrams to show the flow of electricity through them (*e.g., safely dismantle discarded devices, such as heating devices or motorized toys, and draw diagrams to show the loads, conductors and switching mechanisms*)
 - identify similarities and differences between microelectronic circuits and circuits in a house (*e.g., compare switches in a house with transistors in a microcircuit*)
3. Identify and estimate energy inputs and outputs for example devices and systems, and evaluate the efficiency of energy conversions
- identify the forms of energy inputs and outputs in a device or system
 - apply appropriate units, measures and devices in determining and describing quantities of energy transformed by an electrical device, by:
 - measuring amperage and voltage, and calculating the number of watts consumed by an electrical device, using the formula $P = IV$ [power (in watts) = current (in amps) \times voltage (in volts)]
 - calculating the quantity of electric energy, in joules, transformed by an electrical device, using the formula $E = P \times t$ [energy (in joules) = power (in watts) \times time (in seconds)]
 - the concepts of conservation of energy and efficiency to the analysis of energy devices (*e.g., identify examples of energy dissipation in the form of heat, and describe the effect of these losses on useful energy output*)
 - compare energy inputs and outputs of a device, and calculate its efficiency, using the formula, percent efficiency = energy output/energy input \times 100 (*e.g., compare the number of joules of energy used with the number of joules of work produced, given information on electrical consumption and work output of a motor-driven device*)
 - investigate and describe techniques for reducing waste of energy in common household devices (*e.g., by eliminating sources of friction in mechanical components, using more efficient forms of lighting, reducing overuse of appliances as in “overdrying” of clothes*)
4. Describe and discuss the societal and environmental implications of the use of electrical energy
- identify and evaluate sources of electrical energy, including oil, gas, coal, biomass, wind and solar (*e.g., identify and evaluate renewable and nonrenewable sources for generating electricity; evaluate the use of batteries as an alternative to internal combustion engines*)
 - describe the by-products of electrical generation and their impacts on the environment (*e.g., identify by-products and potential impacts of coal-fired electricity generation*)
 - identify example uses of electrical technologies, and evaluate technologies in terms of benefits and impacts (*e.g., identify benefits and issues related to the use of electrical technologies for storing and transmitting personal information*)

- identify concerns regarding conservation of energy resources, and evaluate means for improving the sustainability of energy use

Unit D: Space Exploration (if time permits)

Key Concepts

- technologies for space exploration and observation
- satellites and orbits
- composition and characteristics of bodies in space
- communication technologies
- reference frames for describing position and motion in space
- distribution of matter through space
- life-support technologies

Students will:

1. Investigate and describe ways that human understanding of Earth and space has depended on technological development
 - identify different ideas about the nature of Earth and space, based on culture and science (*e.g., compare geocentric and heliocentric models [Note: knowledge of epicycles is not required]; describe Aboriginal views of space and those of other cultures; describe the role of observation in guiding scientific understanding of space*)
 - investigate and illustrate the contributions of technological advances—including optical telescopes, spectral analysis and space travel—to a scientific understanding of space
 - describe, in general terms, the distribution of matter in star systems, galaxies, nebulae and the universe as a whole
 - identify evidence for, and describe characteristics of, bodies that make up the solar system; and compare their composition and characteristics with those of Earth
 - describe and apply techniques for determining the position and motion of objects in space, including:
 - constructing and interpreting drawings and physical models that illustrate the motion of objects in space (*e.g., represent the orbit of comets around the Sun, using a looped-string model*)
 - describing in general terms how parallax and the Doppler effect are used to estimate distances of objects in space and to determine their motion
 - describing the position of objects in space, using angular coordinates (*e.g., describe the location of a spot on a wall, by identifying its angle of elevation and its bearing or azimuth; describe the location of the Sun and other stars using altitude-azimuth coordinates, also referred to as horizon coordinates or local coordinates*) [Note: A description of star positions based on right ascension and declination is not required.]
 - investigate predictions about the motion, alignment and collision of bodies in space (*e.g., investigate predictions about eclipses; identify uncertainties in predicting and tracking meteor showers*)
2. Identify problems in developing technologies for space exploration, describe technologies developed for life in space, and explain the scientific principles involved
 - analyze space environments, and identify challenges that must be met in developing life-supporting systems (*e.g., analyze implications of variations in gravity, temperature, availability of water, atmospheric pressure and atmospheric composition*)
 - describe technologies for life-support systems, and interpret the scientific principles on which they are based (*e.g., investigate systems that involve the recycling of water and air*)

- describe technologies for space transport, and interpret the scientific principles involved (*e.g., describe the development of multistage rockets, shuttles and space stations; build a model vehicle to explore a planet or moon*)
 - identify materials and processes developed to meet needs in space, and identify related applications (*e.g., medicines, remote sensing, microelectronics, polymers, medical imaging, wireless communication technologies, synthesis of fuels*)
 - describe the development of artificial satellites, and explain the major purposes for which they are used (*e.g., communication, GPS—global positioning system, weather observation*)
3. Describe and interpret the science of optical and radio telescopes, space probes and remote sensing technologies
- explain, in general terms, the operation of optical telescopes, including telescopes that are positioned in space environments
 - explain the role of radio and optical telescopes in determining characteristics of stars and star systems
 - describe and interpret, in general terms, the technologies used in global positioning systems and in remote sensing (*e.g., use triangulation to determine the position of an object, given information on the distance from three different points*) [Note: This example involves the use of geometric approaches rather than mathematical calculations.]
4. Identify issues and opportunities arising from the application of space technology, identify alternatives involved, and analyze implications
- recognize risks and dangers associated with space exploration (*e.g., space junk, fuel expenditure, satellites burning up in the atmosphere, solar radiation*)
 - describe Canadian contributions to space research and development and to the astronaut program (*e.g., Canadarm*)
 - identify and analyze factors that are important to decisions regarding space exploration and development (*e.g., identify examples of costs and potential benefits that may be considered; investigate and describe political, environmental and ethical issues related to the ownership and use of resources in space*)