UNDERGRADUATE HANDBOOK
Department of Ocean Sciences

A guide to undergraduate programs, courses and resources

MEMORIAL UNIVERSITY

July 2017
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INTRODUCTION

What is Ocean Sciences?

Ocean Sciences, or Oceanography, is a field that encompasses the study of the global marine environment from broad geographic and disciplinary perspectives. It essentially looks at the interaction between marine life and oceanic processes, covering such diverse topics as coastal and deep-sea food webs, marine animal ecology, physiology and behaviour, plankton dynamics, the effects of pollution or climate change on ocean life and ecosystems, the management and conservation of aquatic resources, and much more.

Why Study Ocean Sciences?

Our planet is predominantly covered by a vast ocean, which plays a key role in driving its climate and ecosystems, directly or indirectly affecting the lives of most of its inhabitants. Therefore, job opportunities and career perspectives for students with training in Ocean Sciences are extremely varied and rewarding.

Trainees and graduates may find work as laboratory technicians or research assistants in ocean-related fields such as:

- Oceanography
- Marine biology
- Aquaculture
- Fisheries
- Wildlife management

Other potential positions may include, but are not limited to:

- Marine science educator
- Fisheries officer
- Nature interpreter
- Aquarium curator
- Environmental analyst/consultant
- Scuba diver

Importantly, students with a Major in Ocean Sciences are well prepared to undertake graduate studies (MSc, PhD) in various ocean-related fields, leading to further professional and academic positions in government, research or higher education.

Many websites collate information about careers in ocean-related fields, such as Oceancareers, ASLO, and many others. You can even take a cool survey to identify career paths for you in ocean sciences!
The Department of Ocean Sciences and the Ocean Sciences Centre

The Department of Ocean Sciences (DOS) is housed at the Ocean Sciences Centre (OSC) in Logy Bay, which is located approximately 10 kilometers (15 min) from the St. John’s campus of Memorial University. The OSC is a major facility for marine research on the Atlantic coast and is one of Canada’s largest marine laboratories. By virtue of its location, the department provides scientists and students access to the flora and fauna of the northwest Atlantic Ocean and is uniquely situated for shore-based studies of cold-ocean processes and subarctic, Arctic and deep-sea organisms.
Education and training is one of the Department’s principal mandates, and is achieved by providing a stimulating, research-intensive environment in which students can develop and thrive. The Department offers graduate and undergraduate programs, as well as hands-on field and laboratory research experience through part-time and summer research positions for undergraduates. The distinctiveness of the Department’s resources provides an opportunity for interdisciplinary training in cold-ocean and deep-sea research, related to:

- Physiology;
- Biochemistry;
- Molecular biology;
- Biological and chemical oceanography;
- Behavioural and population ecology;
- Aquaculture and fisheries.
UNDERGRADUATE PROGRAMS IN OCEAN SCIENCES

While this Handbook has been prepared with care to provide important and useful details about undergraduate affairs, the most accurate and up-to-date information about programs offered at Memorial University can always be found in the University Calendar.

Bachelor of Science with Major in Ocean Sciences

**Major in Ocean Sciences**

This is an interdisciplinary program administered by the Department of Ocean Sciences, providing a solid foundation in ocean studies, including the basic principles of its main sub-disciplines (physical, chemical, geological, and biological oceanography). See the calendar description here.

**Major in Ocean Sciences (Environmental Systems)**

This program is a stream of the above that provides a geological/geographical context to biological and chemical phenomena in ocean sciences. It also covers such key ocean-related topics as climate change and natural hazards. See the calendar description here.

**Joint Major in Marine Biology**

This program is jointly administered by the Department of Ocean Sciences and the Department of Biology. It consists of core courses in oceanography and biology, and additional courses in various Science subjects. See the calendar description here.

Bachelor of Science with Minor in Ocean Sciences

**Minor in Oceanography**

This is an interdisciplinary program administered by the Department of Ocean Sciences in cooperation with the departments of Biology, Chemistry, Earth Sciences and Physics and Physical Oceanography. It is intended primarily for students in the Faculty of Science but is open to students in other faculties. See the calendar description here.

**Minor in Sustainable Aquaculture and Fisheries Ecology (SAFE)**

This program exposes students to aquaculture and fisheries management practices and helps prepare them for a career in applied marine fields. This is an interdisciplinary program administered by the Department of Ocean Sciences in consultation with the Marine Institute. It is intended primarily for students in the Faculty of Science but is open to students in other faculties. See the calendar description here.
Entrance Requirements

Admission to the Ocean Sciences programs is based on academic standing. To be considered for admission into a Major, students must normally have completed 30 credit hours (typically = 10 courses) with an overall average of at least 65%. The following courses must normally have been completed:

1. English 1090 and 1110 (or equivalent);
2. Mathematics 1000;
3. Physics 1020;
4. Chemistry 1050 and 1051;
5. Biology 1001 and 1002;
6. Earth Sciences 1000;
7. Ocean Sciences 1000 with a minimum grade of 65%.

Note that, because of scheduling and course offerings, it will realistically take three semesters (1.5 years) to complete all these courses. Use the Checklist of Program Completion to keep track of your progress.

Program Objectives

After completion of a Major in Ocean Sciences (4 years, full time), students are expected to have acquired the following skill sets, knowledge and aptitudes.

General skill sets

1. Communication: Graduates will practice effective communication with an awareness of audience and a sense of purpose.
2. Critical thinking: Graduates will skillfully conceptualize, apply, analyze, synthesize, and evaluate information gathered from observation, experience, reflection, reasoning, or communication.
3. Quantitative reasoning: Graduates will accurately use numbers, symbols, measurements, properties, and the relationships of quantities to make sound decisions, judgments, and/or predictions.

Specific Program Objectives of the Major in Ocean Sciences

1. Graduates will demonstrate breadth of knowledge related to ocean environments and processes, including founding principles in mathematics, biology, chemistry, physics and geology.
2. Graduates will understand the dynamic nature of oceans, and the interactions between the benthic and pelagic environments.
3. Graduates will discover and apply practical and quantitative skills appropriate to ocean sciences, including tools and analytical methods employed in modern oceanography and marine biology.
4. Graduates will integrate concepts of ocean sciences with contemporary issues in fisheries, aquaculture, climate change and pollution.
5. Graduates will demonstrate depth of knowledge in at least one of the main areas of ocean sciences, such as biology/ecology of marine organisms, physical/chemical processes in the marine environment, or interaction between earth and ocean systems.
Specific Program Objectives of the Joint Major in Marine Biology

1. Graduates will demonstrate breadth of knowledge related to ocean environments and processes, including founding principles in mathematics, biology, chemistry, physics and geology.
2. Graduates will identify and understand the basic biological levels of organization (e.g. molecules, cells, organisms, communities and ecosystems) and concepts (e.g. biodiversity, evolution).
3. Graduates will discover and apply practical and quantitative skills appropriate to marine biology, including sampling techniques, experimental methods, and principles of data analysis.
4. Graduates will integrate concepts of marine biology with contemporary issues in applied fields such as aquariology, biotechnology, fisheries, aquaculture, and conservation.
5. Graduates will demonstrate depth of knowledge in at least one of organism-level or ecosystem-level marine biology.

Perspectives

As an Ocean Sciences Major, you have the opportunity to customize your program to your personal interests and career goals. In particular, during the third and fourth years of the program, you will have a chance to choose a disciplinary stream or select courses to make your academic record more competitive for a given employment sector. Also consider that if you want to continue your studies at the graduate level, an Honours degree is required by most institutions (there will soon be an Honours section added to this Handbook). It is advisable to consult the Program Coordinator early on to discuss your goals and expectations, and use the Checklist of Program Completion to track your progress.
FIRST YEAR OF PROGRAM

Preparing for & Declaring an Academic Program

Ideally, a student in the first year will prepare for the Bachelor of Science Major program by taking the required 1000-level courses in English, Mathematics and in other Science subjects. After completing 30 credit hours and the necessary course work (see Entrance Requirements), a student can declare a Major using a form called Declaration/Change of Academic Program (available from the Office of the Registrar). This completed form should be brought or emailed to the Program Coordinator in the Department of Ocean Sciences for necessary approval. It then needs to be submitted to the Office of the Registrar. The same process is required to declare a Minor.

Academic Counselling

Upon declaring a Major in Ocean Sciences or Joint Major in Marine Biology, each student will be assigned a Personal Academic Counsellor (PAC), also called an academic advisor, who will normally be a faculty member in the Department. It is strongly recommended to meet with your PAC at the earliest opportunity after enrolling in the program, and follow up with a meeting at least once every semester. Topics that you may want to discuss with your PAC might include:

• Choice of courses, stream or specialization
• Academic progress
• Absences, problems, and/or special circumstances
• Program change or withdrawal
• Career planning

Any of these topics can also be discussed with the Program Coordinator.

Sample First Year Schedule

Major in Ocean Sciences

Importantly, the actual schedule for the first year will vary depending on a student’s background and specific circumstances. Students pursuing a Bachelor of Science with a Major in Ocean Sciences will normally take the following courses during the first year of the program:

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Winter Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 1000</td>
<td>Earth Sciences 1000</td>
</tr>
<tr>
<td>Ocean Sciences 1000</td>
<td>Biology 1002</td>
</tr>
<tr>
<td>Biology 1001</td>
<td>Chemistry 1051</td>
</tr>
<tr>
<td>Chemistry 1050</td>
<td>Ocean Sciences 2100 (or 2000 or 2001)</td>
</tr>
<tr>
<td>English 1090</td>
<td>Statistics 2550</td>
</tr>
</tbody>
</table>

Students who wish to take the Bachelor of Science with a Major in Ocean Sciences (Environmental Systems stream) may elect to take the following courses during the first year of the program:
Joint Major in Marine Biology

Students pursuing a Bachelor of Science with a Joint Major Marine Biology will normally take the following courses during the first year:

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Winter Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 1000</td>
<td>Earth Sciences 1000</td>
</tr>
<tr>
<td>Ocean Sciences 1000</td>
<td>Biology 1000</td>
</tr>
<tr>
<td>Biology 1001</td>
<td>Biology 1002</td>
</tr>
<tr>
<td>Chemistry 1050</td>
<td>Chemistry 1051</td>
</tr>
<tr>
<td>English 1090</td>
<td>Ocean Sciences 2100</td>
</tr>
<tr>
<td>Ocean Sciences 2100</td>
<td>Statistics 2550</td>
</tr>
</tbody>
</table>

Or alternatively:

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Winter Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 1000</td>
<td>Earth Sciences 1000</td>
</tr>
<tr>
<td>Ocean Sciences 1000</td>
<td>Biology 1000</td>
</tr>
<tr>
<td>Biology 1001</td>
<td>Biology 1002</td>
</tr>
<tr>
<td>Chemistry 1050</td>
<td>Chemistry 1051</td>
</tr>
<tr>
<td>English 1090</td>
<td>English 1110</td>
</tr>
<tr>
<td>Ocean Sciences 2100</td>
<td>Ocean Sciences 2100</td>
</tr>
</tbody>
</table>

It is possible to complete this first year schedule at the Grenfell Campus.
SECOND YEAR OF PROGRAM

The Major in Ocean Sciences is an interdisciplinary program that requires a broader than usual introductory coursework (to adequately prepare students for higher-level courses in a diversity of disciplines), which is balanced by a slightly lower number of mandatory courses from the subject of the Major. Therefore, the second year of the Major program typically continues to build on the Science foundation gained during the first year, while also exposing students to a widening variety of courses in Ocean Sciences.

Toward the end of the second year, you may need to start making some important choices, especially if you plan to lean toward a more environmental, biological or applied stream or curriculum. Adequate preparation must be made when thinking of the advanced courses your wish to take in your third and fourth year, and the prerequisites they require.

Sample Second Year Schedule

Major in Ocean Sciences

Importantly, the actual schedule for the first year will vary depending on a student’s background and specific circumstances. Students pursuing a Bachelor of Science with a Major in Ocean Sciences will normally take the following courses during the second year of the program:

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Winter Semester</th>
<th>Intersession/Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 1020</td>
<td>Earth Sciences 1002</td>
<td>Ocean Sciences 2500</td>
</tr>
<tr>
<td>English 1110</td>
<td>Physics 1021</td>
<td></td>
</tr>
<tr>
<td>Science elective* 1 (Geography 1050)</td>
<td>Ocean Sciences 2000</td>
<td></td>
</tr>
<tr>
<td>Science elective 2 (Biology 2122)</td>
<td>Ocean Sciences 2001</td>
<td></td>
</tr>
<tr>
<td>Science elective 3 (Geography 2195)</td>
<td>Ocean Sciences 2200</td>
<td></td>
</tr>
</tbody>
</table>

*Examples of suitable electives that are often listed as prerequisite are provided in parenthesis.

Students who wish to take the Bachelor of Science with a Major in Ocean Sciences (Environmental Systems stream) may elect to take the following courses during the second year of the program (this schedule is compatible with a first year that was completed at the Grenfell Campus; see year 1):

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Winter Semester</th>
<th>Intersession/Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean Sciences 1000</td>
<td>Physics 1021</td>
<td>Ocean Sciences 2500</td>
</tr>
<tr>
<td>Statistics 2550</td>
<td>Ocean Sciences 2000</td>
<td></td>
</tr>
<tr>
<td>Science elective* 1 (Geography 1050)</td>
<td>Ocean Sciences 2001</td>
<td></td>
</tr>
<tr>
<td>Science elective 2 (Biology 2122)</td>
<td>Ocean Sciences 2100</td>
<td></td>
</tr>
<tr>
<td>Science elective 3 (Geography 2195)</td>
<td>Ocean Sciences 2200</td>
<td></td>
</tr>
</tbody>
</table>

*Examples of suitable electives that are often listed as prerequisite are provided in parenthesis.
Joint Major in Marine Biology

Students pursuing a Bachelor of Science with a Joint Major Marine Biology will normally take the following courses during the second year:

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Winter Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 1020</td>
<td>Physics 1021</td>
</tr>
<tr>
<td>Biochemistry 2101</td>
<td>Ocean Sciences 2000</td>
</tr>
<tr>
<td>Biology 2250</td>
<td>Ocean Sciences 2001</td>
</tr>
<tr>
<td>Chemistry 2440</td>
<td>Biology 2060</td>
</tr>
<tr>
<td>Biology elective</td>
<td>Ocean Sciences 2200</td>
</tr>
</tbody>
</table>

Or alternatively:

<table>
<thead>
<tr>
<th>Fall Semester</th>
<th>Winter Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 1020</td>
<td>Physics 1021</td>
</tr>
<tr>
<td>Biochemistry 2101</td>
<td>Ocean Sciences 2001</td>
</tr>
<tr>
<td>Biology 2250</td>
<td>Biology 2060</td>
</tr>
<tr>
<td>Chemistry 2400</td>
<td>Chemistry 2401</td>
</tr>
<tr>
<td>Statistics 2550</td>
<td>Biology 2900</td>
</tr>
</tbody>
</table>

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THIRD AND FOURTH YEARS OF PROGRAM

While there is no need to formally specialize your program (you can keep your options open and stay flexible, mixing and matching courses along the way), those who so wish it can choose concentrations or streams in Ocean Sciences among:

Environmental Systems

This is a formal stream of the Major in Ocean Sciences, with a curriculum that blends foundation courses in earth and ocean sciences, with a focus on environmental issues. It is designed for students with special interest in geography (e.g. cartography, remote sensing), climate, natural resources and marine geology.

Marine Biology – Ecology & Evolution

This concentration focuses on evolutionary and ecological principles at the organismal and ecosystem levels. Essentially, it centres on marine life at the macroscopic scale, including the behaviours of marine organisms, the connections among species and the interactions between living organisms and the marine environment. This concentration can be achieved either through selected curriculum within the Major in Ocean Sciences, or through the Joint Major in Marine Biology.

Marine Biology – Physiology & Molecular Biology

This is a concentration that dives deeper into the intricate workings of marine organisms. At this level of organization, students gain greater knowledge of cellular and molecular processes, right down to the genes. This concentration can be achieved either through selected curriculum within the Major in Ocean Sciences, or through the Joint Major in Marine Biology.

Applied Ocean Sciences

This curriculum specialization favours course work with a more practical approach and focuses on such topics as fisheries and aquaculture. The Department of Ocean Sciences and the School of Fisheries of the Marine Institute are currently working together to develop a Joint Major in Aquaculture & Fisheries (or a formal program along these lines) – so stay tuned.
Foundation Courses (1000/2000-level)

The following are examples of courses in Ocean Sciences that students will normally take in the first two years of the program. Importantly, there might be exceptions, as the actual selection of courses taken will vary depending on a student’s background, schedule and program requirements. While these courses are typically offered in the same semester every year, exceptional circumstances may occur. It is the responsibility of the student to seek out the most up-to-date information on course offerings, in consultation with the Program Coordinator.

Ocean Sciences 1000

**Exploration of the World Ocean** is an introductory course covering the major ocean sciences (biology, chemistry, geology, physics) at a level sufficient for science majors but accessible to non-science majors. It explores phenomena occurring from the shoreline to the abyss and from equatorial to Polar Regions. It also examines principles of marine ecology as well as how the marine environment affects humans and vice versa. The course is offered in a blended format that combines face-to-face lectures and online interactive activities in the form of virtual oceanographic expeditions. *This course is a prerequisite to most subsequent courses in ocean Sciences. It is generally taken in the first semester of the program.*

- Lectures: 1.5 hours per week
- Online Interactive Activities: 90 minutes per week
- Prerequisite: None

Ocean Sciences 2000

**Introductory Biological Oceanography** provides a general understanding of the biological processes that occur in coastal and oceanic environments. It introduces students to the major groups of bacteria, phytoplankton, invertebrates and fish, emphasizing the biotic and abiotic factors controlling primary production and marine biomass. It shows how the physical, chemical, and geological environments interact with biology to define processes and patterns affecting nutrients and life in marine ecosystems. *This course can be taken in the first or second year.*

- Lectures: Three hours per week
- Prerequisite: Ocean Sciences 1000 and a 1000-level course in one of Biology, Chemistry, Earth Sciences or Physics

Ocean Sciences 2001

**Introduction to Sustainable Fisheries and Aquaculture** introduces students to the breadth of aquaculture and fisheries science and the variety of animal species cultured and harvested. Basic aspects of aquaculture and fisheries and the links between the two are covered, including production systems, capture fisheries, environmental interactions, and the physiology, ecology and reproduction of finfish and shellfish in the context of their culture and harvest. *This course can be taken in the first or second year.*

- Lectures: Three hours per week
- Prerequisite: Ocean Sciences 1000 or Biology 1002
Handbook of Undergraduate Studies in Ocean Sciences

Ocean Sciences 2100

**Introductory Chemical Oceanography** (same as Chemistry 2610) provides an introduction to the fundamental chemical properties of seawater and the processes governing the concentrations of elements and compounds in the oceans. It is an introduction to the sources, distribution, and transformations of chemical constituents of the ocean, and their relation to biological, chemical, geological, and physical processes. Topics include: controls on average concentration of chemicals in the ocean; vertical and horizontal distributions of ocean constituents; air-sea interactions; production, export, and remineralization of organic matter; the ocean carbon cycle; human-induced changes; stable isotopes; and trace elements. *This course can be taken in the first or second year, but works best in the second semester for most schedules.*

Lectures: Three hours per week

Prerequisite: Chemistry 1011 or 1051 which may be taken concurrently or Chemistry 1001

Ocean Sciences 2200

**Introductory Geological Oceanography** (same as Earth Sciences 2919) is a study of the formation and evolution of oceans, including plate tectonics, mid-ocean ridges (birth place of oceans), subduction zones (where oceans are consumed), sedimentary environments such as estuaries, deltas, beaches and barrier islands, continental shelves, slopes and deep abyssal plains and special topics, including anoxic events, evolution of tides, atmosphere-ocean interactions, formation of banded iron formations, snowball Earth, black and white smokers, and how Earth modulates its climate through atmosphere, hydrosphere, biosphere and lithosphere interactions.

Lectures: Three hours per week

Prerequisite: Earth Sciences 1000

Ocean Sciences 2300

**Introductory Physical Oceanography** (same as Physics 2300) provides an introduction to the physical ocean. Ocean characteristics studied include: the properties of seawater, key features of ocean circulation, wind-forcing in the ocean, tides and shoreline processes as well as ocean coupling with the atmosphere, geosphere and cryosphere (ice) and new approaches to ocean sampling and numerical modelling. The course takes an integrated earth systems approach to the study of upwelling zones, open ocean ecosystems and climate change.

Lectures: Three hours per week

Prerequisite: any two first-year courses in Physics

NOTE: due to the above prerequisite, this course is often taken in the third year of the Ocean Sciences programs
Ocean Sciences 2500

**Introduction to Practical Ocean Sciences** explores the instruments, techniques and analytical methods commonly used to study marine life and processes, chiefly focusing on the interaction between living organisms and their chemical, physical and geological environment. The course combines ship-based or shore-based sampling and data collection with laboratory investigation in an intensive 2-week long format. It is primarily intended for mid-level undergraduate students majoring in Ocean Sciences. This course will either be offered during a special session following the winter semester, or in the spring semester.

Prerequisite: Ocean Sciences 1000, and at least three of Ocean Sciences 2000 (or BIOL 3710), 2100, 2200, 2300

NOTE: This hands-on course is generally taken at the end of the second year.

**IMPORTANT:** All courses with a laboratory/experimental component have Science 1807 (Safety in the Scientific Laboratory) as a prerequisite. This course is offered online and takes about 2 hours to complete (there are no associated credits).

Advanced Courses (3000/4000 level)

A selection of advanced course outlined below is normally taken in the last two years of the program.

Ocean Sciences 3000

**Aquaculture Principles and Practices** emphasizes the techniques and methods used to culture finfish and shellfish, with a primary focus on Canadian aquaculture species. Basic aspects of aquaculture will be covered, including the design and maintenance of production systems, culture techniques, and the nutrition, health, physiology and reproduction of finfish and shellfish. The laboratory portion of this course will provide students with practical experience in the maintenance of land-based aquaculture production systems and in the husbandry/culture of aquatic organisms.

Lectures: Three hours per week

Prerequisite: Ocean Sciences 2001, or Ocean Sciences 1000 and Biology 1002

Ocean Sciences 3002

**Aquaculture and Fisheries Biotechnology** is an introduction to biotechnology and genetics as they are applied to aquaculture and fisheries. Topics covered include genetic variation; genetic structure of fish and shellfish populations; the genetic basis of aquaculture traits; finfish and shellfish genomic research; marker-assisted selection in aquaculture; manipulation of ploidy; genetic engineering in aquaculture; and techniques used to study the responses of aquatic animals to external stressors such as hypoxia, temperature stress, acidification, and pathogens.

Lectures: Three hours per week

Prerequisite: Biology 2250 or Biochemistry 2100
Ocean Sciences 3620

Aquatic Microbial Ecology (same as Biology 3620) is a study of the nature, distribution and activities of microorganisms in the freshwater and marine environments. Field and laboratory work illustrate some of the investigative techniques used in this field of study.

Lectures: Three hours per week
Prerequisite: Biology 2600 and 3050, Statistics 2550 or equivalent

Ocean Sciences 3640

Environmental Physiology of Animals (same as Biology 3640) covers physiological adaptations of animals facilitating their survival in natural environments with emphasis on physiological and biochemical responses of animals to extreme environments. Starting with the fundamental basis of physiological mechanisms, the course explores various aspects and the integration of major physiological processes (metabolism, respiration, osmoregulation) and how these relate to ecological niche.

Lectures: Three hours per week
Prerequisite: Biology 2060; Biochemistry 3106

Ocean Sciences 4000

Scientific Diving Methods is an in-depth study and application of methods routinely employed for data collection in underwater scientific research. Aspects covered include habitat mapping; installation and use of instrumentation; still and video camera techniques; planning and execution of surveys and experiments in major subtidal habitats; as well as data analysis and interpretation. Participants are trained in accordance with Memorial University of Newfoundland’s Guide for Diving Safety and the Canadian Association for Underwater Science (CAUS) standards to meet the criteria for Scientific Diver I rating. This course is normally offered at the Bonne Bay Marine Station in a special 2-week session at the beginning or end of the Spring semester depending on station’s availability.

Prerequisite: Biology 2122 or 3709; Biology 2600 or Ocean Sciences 2000 or Environmental Science 2371, Statistics 2550 or equivalent

NOTE: The following documentation must be provided to the course instructor at least four months before the first day of the course. It must be in effect until at least the last day of the course. Submission of this documentation does not guarantee acceptance into the course. Aside from course prerequisites, acceptance will be based on successful completion, before the course begins, of a diving fitness and skills evaluation in a pool environment and demonstration of understanding of the MUN Diving Safety Manual, physics and physiology of diving, and use of recreational dive tables. Nationally recognized scuba diver certification with diver rescue and accident management techniques; diver medical examination by a licensed physician knowledgeable in diving medicine; First Aid (basic), CPR (basic), and DAN oxygen first aid for scuba diving injuries administration cards; DAN membership and insurance or medical insurance covering hyperbaric treatment; diver’s log book with at least 12 dives in the last 12 months including one dive in the last six months and four dives in cold (<10°C) water; cold-water scuba diving equipment complete with proper hydrostatic/VIP service tags on diving cylinders and overhaul/service receipts on regulators and buoyancy compensator devices. All required equipment and supporting documentation is at the student’s own expense.
Ocean Sciences 4100

Marine Pelagic Food Webs examines the structure, function and dynamics of pelagic food webs in the marine environment. The course will focus on the material and energy flows within and among trophic levels and the interactions with major biogeochemical cycles and climate.

Lectures: Three hours per week
Prerequisite: Biology 1002 or 2120; and Ocean Sciences 2000 or Biology 3710

Ocean Sciences 4122

Advanced Studies in Marine Animal Diversity (same as Biology 4122) provides an in-depth examination of cellular, physiological, behavioural and ecological adaptations in marine animals. Lectures will be combined with discussions of relevant papers from the primary literature on topics of current interest which may relate morphology, ecology, evolution, natural history, species interactions and practical applications. Students will also gain hands-on experience by designing and conducting research projects involving live or preserved animals.

Lectures: either three hours of lecture and three hours of laboratory per week or a two-week intensive course that embodies equivalent instructional time
Prerequisite: Biology 2122 and Biology 2600

Ocean Sciences 4601

Functional Biology of Fish (same as Biology 4601) is an introduction to anatomical physiological and cellular processes in the life cycle of fishes.

Lectures: Three hours per week
Prerequisite: Biology 2060; Biology 2210 or 3202; and Biology 3401 or 3640
## CONTACT INFORMATION

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<thead>
<tr>
<th>Contact Information</th>
<th>Description</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Office DOS (Logy Bay)</strong></td>
<td>- General inquiries&lt;br&gt;- OS 3017</td>
<td>3708</td>
<td><a href="mailto:ocean@mun.ca">ocean@mun.ca</a></td>
</tr>
<tr>
<td><strong>Intermediate Clerk – JoAnn Greening</strong></td>
<td>- Front desk&lt;br&gt;- Mail&lt;br&gt;- Booking of the Challenger Room</td>
<td>3708</td>
<td><a href="mailto:jsgreening@mun.ca">jsgreening@mun.ca</a></td>
</tr>
<tr>
<td><strong>Intermediate Secretary – Winnie Sparkes</strong></td>
<td>- Undergraduate secretarial matters&lt;br&gt;- Stipends, payments&lt;br&gt;- Reimbursements</td>
<td>2767</td>
<td><a href="mailto:wsparkes@mun.ca">wsparkes@mun.ca</a></td>
</tr>
<tr>
<td><strong>Department Head – Dr. Garth Fletcher</strong></td>
<td></td>
<td>2767</td>
<td><a href="mailto:fletcher@mun.ca">fletcher@mun.ca</a></td>
</tr>
<tr>
<td><strong>Administrative Assistant – Marsha Roche</strong></td>
<td>- Financial matters concerning policy and travel&lt;br&gt;- Access card (after hours)&lt;br&gt;- Travel issues / telephone issues</td>
<td>3709</td>
<td></td>
</tr>
<tr>
<td><strong>Program Coordinator (undergraduate and graduate affairs) – Danielle Nichols</strong></td>
<td>- Questions about programs&lt;br&gt;- Program forms&lt;br&gt;- Courses offered&lt;br&gt;- Scheduling</td>
<td>2459</td>
<td><a href="mailto:ocean@mun.ca">ocean@mun.ca</a>&lt;br&gt;<a href="mailto:dNichols@mun.ca">dNichols@mun.ca</a></td>
</tr>
<tr>
<td><strong>Deputy Head and Undergraduate Student Officer – Dr. Annie Mercier</strong></td>
<td>- Undergraduate program development</td>
<td>2011</td>
<td><a href="mailto:amercier@mun.ca">amercier@mun.ca</a></td>
</tr>
<tr>
<td><strong>Graduate Student Officer – Dr. Kurt Gamperl</strong></td>
<td>- Graduate program development</td>
<td>2692</td>
<td><a href="mailto:kgamperl@mun.ca">kgamperl@mun.ca</a></td>
</tr>
</tbody>
</table>

The Department of Ocean Sciences is housed at the Ocean Sciences Centre (OSC) in Logy Bay. Information on how to get there (shuttle service) and the full list of faculty, staff, research assistants and graduate students can be found on the Department’s website.
IMPORTANT LINKS & RESOURCES

General

Faculty of Science help centres
https://www.mun.ca/science/students/help.php

Forms

From the Office of the Registrar
https://www.mun.ca/regoff/forms.php

Online Application
http://www.mun.ca/undergrad/apply

Declaration/Change of Academic Program (Faculty of Sciences)
https://www.mun.ca/regoff/Declare_Change_Academic_Program.pdf

Course Change Form
https://www.mun.ca/regoff/registration/Course_Change_Form_2013.pdf

Prerequisite Waiver

Deferring a Final Exam
http://www.mun.ca/osc/undergrad/DEFERRING_A_FINAL_EXAM.pdf

Request for Degree Advice
https://www.mun.ca/regoff/Request_for_Degree_Advice.pdf
Research, Training & Funding

Get Involved in Research
http://www.mun.ca/science/students/research.php

NSERC Undergraduate Student Research Award (USRA)
http://www.mun.ca/research/funding/opportunities/opportunity.php?id=198

Science Undergraduate Research Award (SURA)
http://www.mun.ca/science/students/sura.php

Other Scholarships
http://www.mun.ca/scholarships/home/

MUCEP Positions (part-time)
http://www.mun.ca/cdel/jobs_for_students/MUCEP/
# APPENDIX 1 – CHECKLIST OF PROGRAM COMPLETION

## Major in Ocean Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Completed</th>
<th>Prerequisite(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1090 (or 1080)</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>English 1110</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Mathematics 1000</td>
<td></td>
<td>MATH 1090 or test</td>
<td></td>
</tr>
<tr>
<td>Physics 1020</td>
<td></td>
<td>Level III MATH or MATH 1090</td>
<td></td>
</tr>
<tr>
<td>Chemistry 1050</td>
<td></td>
<td>Science 1807*</td>
<td></td>
</tr>
<tr>
<td>Chemistry 1051</td>
<td></td>
<td>CHEM 1050</td>
<td></td>
</tr>
<tr>
<td>Biology 1001</td>
<td></td>
<td>Science 1807*</td>
<td></td>
</tr>
<tr>
<td>Biology 1002</td>
<td></td>
<td>BIOL 1001</td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 1000</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 1000</td>
<td></td>
<td>None</td>
<td>Minimum grade of 65%</td>
</tr>
<tr>
<td>Physics 1021</td>
<td></td>
<td>PHYS 1020; MATH 1000</td>
<td></td>
</tr>
<tr>
<td>Statistics 2550</td>
<td></td>
<td>MATH 1000</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 2000</td>
<td></td>
<td>OCSC 1000; any 1000-level Science course</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 2001</td>
<td></td>
<td>OCSC 1000; BIOL 1002</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 2100</td>
<td></td>
<td>CHEM 1051</td>
<td>PR may be taken concurrently</td>
</tr>
<tr>
<td>Ocean Sciences 2200</td>
<td></td>
<td>EASC 1000; Two 1000-level Physics</td>
<td>At least 1 of these 2 courses must</td>
</tr>
<tr>
<td>Ocean Sciences 2300</td>
<td></td>
<td>OCSC 1000; at least three of OCSC 2000, 2100, 2200, 2300</td>
<td>be completed</td>
</tr>
<tr>
<td>Ocean Sciences 2500</td>
<td></td>
<td>OCSC 1000; at least three of OCSC 2000, 2100, 2200, 2300</td>
<td></td>
</tr>
<tr>
<td>Minimum 3 courses in Ocean Sciences at the 3000/4000 level</td>
<td></td>
<td>Specific to each course</td>
<td>For example, Ocean Sciences 3000, 3002, 3620, 3640, 4000, 4100, 4122, 4601 (or others)</td>
</tr>
<tr>
<td>Additional course to reach 30 credit hours in Ocean Sciences</td>
<td></td>
<td>Specific to each course</td>
<td>Any OCSC course at any level is eligible</td>
</tr>
<tr>
<td>Extra Science courses required to reach 78 credit hours in Science**</td>
<td></td>
<td>Specific to each course</td>
<td></td>
</tr>
</tbody>
</table>

*Science 1807 (Safety in the Scientific Laboratory) is required for all courses with a laboratory component. It is offered online and takes about 2 hours to complete (there are no associated credits).

**Additionally, elective courses (in any subject) must be completed to reach 120 credit hours (generally equivalent to 40 courses).
### Major in Ocean Sciences (Environmental Systems)

<table>
<thead>
<tr>
<th>Course</th>
<th>Completed</th>
<th>Prerequisite(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1090 (or 1080)</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>English 1110</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Mathematics 1000</td>
<td></td>
<td>MATH 1090 or test</td>
<td></td>
</tr>
<tr>
<td>Physics 1020</td>
<td></td>
<td>Level III MATH or MATH 1090</td>
<td></td>
</tr>
<tr>
<td>Chemistry 1050</td>
<td></td>
<td>Science 1807*</td>
<td></td>
</tr>
<tr>
<td>Chemistry 1051</td>
<td></td>
<td>CHEM 1050</td>
<td></td>
</tr>
<tr>
<td>Biology 1001</td>
<td></td>
<td>Science 1807*</td>
<td></td>
</tr>
<tr>
<td>Biology 1002</td>
<td></td>
<td>BIOL 1001</td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 1000</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 1000</td>
<td></td>
<td>None</td>
<td>Minimum grade of 65%</td>
</tr>
</tbody>
</table>

**A Major can be declared once the above have been completed with min grade average of 65%.**

<table>
<thead>
<tr>
<th>Course</th>
<th>Completed</th>
<th>Prerequisite(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 1021</td>
<td></td>
<td>PHYS 1020; MATH 1000</td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 1002</td>
<td></td>
<td>EASC 1000</td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 2502</td>
<td></td>
<td>EASC 1000 and 1002; CHEM 1051</td>
<td></td>
</tr>
<tr>
<td>Geography 1050</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Geography 2102</td>
<td></td>
<td>GEOG 1050</td>
<td>At least 2 of these 3 courses must be completed</td>
</tr>
<tr>
<td>Geography 2195</td>
<td></td>
<td>None GEOG 1050</td>
<td></td>
</tr>
<tr>
<td>Geography 2425</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistics 2550</td>
<td></td>
<td>MATH 1000</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 2000</td>
<td></td>
<td>OCSC 1000; any 1000-level Science course</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 2001</td>
<td></td>
<td>OCSC 1000; BIOL 1002</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 2100</td>
<td></td>
<td>CHEM 1051</td>
<td>PR may be taken concurrently</td>
</tr>
<tr>
<td>Ocean Sciences 2200</td>
<td></td>
<td>EASC 1000</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 2300</td>
<td></td>
<td>Two 1000-level Physics</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 2500</td>
<td></td>
<td>OCSC 1000; at least three of OCSC 2000, 2100, 2200, 2300</td>
<td></td>
</tr>
<tr>
<td>Minimum 3 courses in</td>
<td></td>
<td>Specific to each course</td>
<td>For example, Ocean Sciences 3000, 3002, 3620, 3640, 4000, 4100, 4122, 4601 (or others)</td>
</tr>
<tr>
<td>Ocean Sciences at the 3000/4000 level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum 3 courses in</td>
<td></td>
<td>Specific to each course</td>
<td></td>
</tr>
<tr>
<td>Geography or Earth Sciences at the 3000/4000 level**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Science 1807* (Safety in the Scientific Laboratory) is required for all courses with a laboratory component. It is offered online and takes about 2 hours to complete (there are no associated credits).

**Additionally, elective courses (in any subject) must be completed to reach 120 credit hours (generally equivalent to 40 courses).
### Joint Major in Marine Biology

<table>
<thead>
<tr>
<th>Course</th>
<th>Completed</th>
<th>Prerequisite(s)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1090 (or 1080)</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>English 1110</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Mathematics 1000</td>
<td></td>
<td>MATH 1090 or test</td>
<td></td>
</tr>
<tr>
<td>Physics 1020</td>
<td></td>
<td>Level III MATH or MATH 1090</td>
<td></td>
</tr>
<tr>
<td>Chemistry 1050</td>
<td></td>
<td>Science 1807*</td>
<td></td>
</tr>
<tr>
<td>Chemistry 1051</td>
<td></td>
<td>CHEM 1050</td>
<td></td>
</tr>
<tr>
<td>Biology 1001</td>
<td></td>
<td>Science 1807*</td>
<td></td>
</tr>
<tr>
<td>Biology 1002</td>
<td></td>
<td>BIOL 1001</td>
<td></td>
</tr>
<tr>
<td>Earth Sciences 1000</td>
<td></td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Ocean Sciences 1000</td>
<td></td>
<td>None</td>
<td>Minimum grade of 65%</td>
</tr>
</tbody>
</table>

A Major can be declared once the above have been completed with min grade average of 65%.

- Physics 1021
  - PHYS 1020; MATH 1000
- Statistics 2550
  - MATH 1000
- Biology 2060
  - BIOL 1001/02; BIOL 2250; CHEM 2440 or 2400
- Biology 2122
  - BIOL 1001/02
- Biology 2250
  - BIOL 1001/02; CHEM 1050/51
- Biology 2600
  - BIOL 1001/02
- Biology 2900
  - BIOL 1001/02; BIOL 2250; STAT 2550
- Biology 3711
  - BIOL 2122 and 2660
- Ocean Sciences 2000
  - OCSC 1000; any 1000-level Science course
  - BIOL 2122 and 2660
  - Only 1 of these 2 must be completed (they are credit restricted; note the different PR)
- Biology 3710
- Ocean Sciences 2001
  - OCSC 1000; BIOL 1002
- Ocean Sciences 2100
  - CHEM 1051
  - PR may be taken concurrently
- Ocean Sciences 2200
- Ocean Sciences 2300
  - EASC 1000
  - Two 1000-level Physics
  - At least 1 of these 2 courses must be completed
- Ocean Sciences 2500
  - OCSC 1000; at least three of OCSC 2000, 2100, 2200, 2300
- Additional courses to reach 33 credit hours in Ocean Sciences (12 credit hours at the 3000/4000 level)
  - Specific to each course
  - For example, Ocean Sciences 3000, 3002, 3620, 3640, 4000, 4100, 4122, 4601 (or others)
- Additional courses to reach 33 credit hours in Biology**
  - Specific to each course

*Science 1807 (Safety in the Scientific Laboratory) is required for all courses with a laboratory component. It is offered online and takes about 2 hours to complete (there are no associated credits).

**Additionally, elective courses (in any subject) must be completed to reach 120 credit hours (generally equivalent to 40 courses).