

# BIOLOGY (BIOL)

Updated March 13, 2013

**Note: The department/program code BIOL replaces the former code 05. Students cannot hold credit in BIOL-xxxx and the former 05.xxxx having the same course number (e.g., BIOL-1115(3) and 05.1115(3)).**

**Chair: Associate Professor E.H. Byard;** Professors Emeriti: W.S. Evans, M. Novak, R.A. Woods; Senior Scholars: G.E.E. Moodie, R.J. Staniforth; Professors: A. Civetta, L.S. Forbes, J.D. Huebner, E. Pip, J. Tardif, A.R. Westwood, M.D. Wiegand; Associate Professors: R. Anderson, J. Franck, S. Good, P.W. Holloway, A. Park, C. Willis; Assistant Professors: G. Avila-Sakar, R. Douville, S. Lingle, A. Shrivastav; Instructors: L. Anderson, B. Biernacka, C. DuGuay, M.C. Hardy, N.L. Loadman, A. McGreevy, K. Muc, D.A.H. Rittberg, N.K. Simmons; Administrative Technologist: L. Hemphill; Technical Staff: L.G. Buchanan, R. Cole, H. Copp, D. Nickel, M. Rondeau, B. VanDekerkhove.

## DEGREES/PROGRAMS OFFERED

**3-Year BSc**

**3-Year BSc (Business Stream)**

**4-Year BSc**

**4-Year BSc (Business Stream)**

**Honours BSc**

**4-Year BSc (UW/RRC)**

## INTRODUCTION

The study of Biology encompasses any manifestation of life, from the DNA molecule to the interactions of organisms within the various ecosystems of the earth. This broad discipline includes the subject areas of Botany, Zoology, Microbiology, Ecology, Genetics and Molecular Biology.

The Biology Department offers the 3-Year BSc, 4-Year BSc, and BSc Honours degrees. Two additional degree options available are the University of Winnipeg/Red River College 4-Year BSc in Applied Biology, and a Co-operative Program that combines a 3-Year BSc Degree in Biology with a diploma in Chemical and Biosciences Technology.

Students pursuing a 3-year or 4-year BSc in Biology have the opportunity to take a Business Stream – a set of core courses in the Faculty of Business that will provide them with the skills needed to enter and succeed in industry and business. See the "Science with a Business Stream" section of this Course Calendar.

In addition, courses in Biology constitute the core of the Environmental Studies Forest Ecology Program, the Forest Policy and Management Program, and the Biochemistry Program.

A BSc in Biology can lead to employment in Conservation or other government departments, work as a technologist in a research or industrial laboratory, as well as a career in education. It also provides the preparation necessary for those entering several professional programs including Dentistry, Medicine, Veterinary Medicine, Pharmacy and Optometry.

Many Biology graduates also pursue post-graduate education. The necessary academic preparation for post-graduate studies is **only** provided by the 4-Year and Honours degrees in Biology. The 3-Year BSc and the Applied Biology degrees are not recognized as adequate preparation by most Graduate Studies Programs in Canada or internationally.

## REQUIREMENTS FOR A 3-YEAR BSc IN BIOLOGY

<b>ADMISSION REQUIREMENT</b>	Students should consult with a member of the Department in planning their course of study.
<b>GRADUATION REQUIREMENT</b>	90 credit hours
<b>RESIDENCE REQUIREMENT</b>	
Degree:	Minimum 30 credit hours
Major:	Minimum 18 credit hours
<b>GENERAL DEGREE REQUIREMENT</b>	
Humanities:	12 credit hours in Humanities
Writing:	Minimum 3 credit hours of Academic Writing.
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.
<b>MAJOR REQUIREMENT</b>	
Single Major:	Minimum 30 credit hours/Maximum 48 credit hours in the Major subject.
Double Major:	30 credit hours in Biology and specified number of credit hours in the other department/program.
Required courses:	
	<b>BIOL-1115(3)</b> Cells and Cellular Processes, and <b>BIOL-1116(3)</b> Evolution, Ecology and Biodiversity.
	Minimum 24 credit hours in other Biology courses at or above the 2000 level, not including <b>BIOL-4111(6)</b> Biology Honours Thesis.

Minimum 18 credit hours, at or above the 1000 level, selected from at least 2 (two) Departments of Chemistry, Geography (Physical Geography courses only), Mathematics, Physics, and Statistics INCLUDING at least 3 credit hours of statistics chosen from the following courses:

STAT-1301(3) Statistical Analysis I  
STAT-1501(3) Elementary Biological Statistics I  
GEOG-2309(3) Statistical Techniques in Environmental Analysis  
PSYC-2101(3) Introduction to Data Analysis  
The former STAT-1201(6) Introduction to Statistical Analysis

The following courses do not qualify:

CHEM-2801(3) Chemistry and Society  
PHYS-1701(6) Astronomy  
PHYS-2705(6) Cosmology: Science Fact to Science Fiction

Combined Major: Minimum 48 credit hours from two (2) different majors with not less than 18 credit hours from each major subject.

Prescribed courses:

**BIOL-1115(3)** Cells and Cellular Processes  
**BIOL-1116(3)** Evolution, Ecology and Biodiversity

Restrictions: Only 6 credit hours at the 1000 level will be credited towards the combined major. Any other 1000-level course would be considered as an elective.

## REQUIREMENTS FOR THE 3-YEAR BSc IN BIOLOGY WITH A BUSINESS STREAM

Students must complete the requirements of the 3-year BSc in Biology degree (see previous section) and the set of core courses indicated in the "Science with a Business Stream" section of the Calendar.

## REQUIREMENTS FOR A 4-YEAR BSc IN BIOLOGY

<b>ADMISSION REQUIREMENT</b>	Students must consult with the Department Advisor in planning their studies.
<b>GRADUATION REQUIREMENT</b>	120 credit hours, that is, 90 credit hours meeting the requirements for the 3-Year BSc plus an additional 30 credit hours.
<b>RESIDENCE REQUIREMENT</b>	
Degree:	Minimum 60 credit hours
Major:	Minimum 30 credit hours
<b>GENERAL DEGREE REQUIREMENT</b>	
Humanities:	12 credit hours
Writing:	Minimum 3 credit hours of Academic Writing.
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.
<b>MAJOR REQUIREMENT</b>	
Single Major:	Minimum 48 credit hours/Maximum 78 credit hours in the Major subject.
Double Major:	Minimum 48 credit hours in Biology and specified number of courses in other Major.
Required courses:	
	<b>BIOL-1115(3)</b> Cells and Cellular Processes
	<b>BIOL-1116(3)</b> Evolution, Ecology and Biodiversity
	<b>BIOL-2301(3)</b> Genetics or the former BIOL-3301(3)
	<b>BIOL-2403(3)</b> Principles of Ecology
	(or former <b>BIOL-3403(3)</b> ) or <b>BIOL-3902(3)</b> Microbial Ecology)
	<b>BIOL-3221(3)</b> Cell Biology

Minimum 24 credit hours, at or above the 1000 level, selected from at least 2 (two) Departments of Chemistry, Geography (Physical Geography courses only), Mathematics, Physics, and Statistics INCLUDING at least 6 credit hours of statistics chosen from the following options:

STAT-1301(3) Statistical Analysis I and STAT-1302(3) Statistical Analysis II or the former STAT-1201(6) Introduction to Statistical Analysis

- OR** STAT-1501(3) Elementary Biological Statistics I **AND ONE OF** STAT-2001(3) Elementary Biological Statistics II **or** BIOL-3492(3) Quantitative & Theoretical Biology **or** BIOL-4471(3) Ecological Methods or the former STAT-1601(3) Elementary Biological Statistics II
- OR** GEOG-2309(3) Statistical Techniques in Environmental Analysis **AND ONE OF** BIOL-3492(3) Quantitative & Theoretical Biology **or** BIOL-4471(3) Ecological Methods
- OR** PSYC-2101(3) Introduction to Data Analysis **AND ONE OF** PSYC-2102(3) Introduction to Research Methods **or** BIOL-3492(3) Quantitative & Theoretical Biology **or** BIOL-4471(3) Ecological Methods

The following courses do not qualify:

- CHEM-2801(3) Chemistry and Society
- PHYS-1701(6) Astronomy
- PHYS-2705(6) Cosmology: Science Fact to Science Fiction

Students must complete minimum 42 credit hours in Biology above the 1000 level.

Students taking the 4-Year BSc in preparation for graduate studies are strongly advised to enrol in the BSc Honours program (see below).

Combined Major: Minimum 60 credit hours from two (2) different majors with not less than 24 credit hours from each major subject.

Prescribed courses:

- BIOL-1115(3)** Cells and Cellular Processes
- BIOL-1116(3)** Evolution, Ecology and Biodiversity

Restrictions: Only 6 credit hours at the 1000 level will be credited towards the combined major. Any other 1000-level course would be considered as an elective.

## REQUIREMENTS FOR THE 4-YEAR BSc IN BIOLOGY WITH A BUSINESS STREAM

Students must complete the requirements of the 4-year BSc in Biology degree (see previous section) and the set of core courses indicated in the "Science with a Business Stream" section of the Calendar.

## REQUIREMENTS FOR AN HONOURS BSc IN BIOLOGY

<b>ADMISSION REQUIREMENT</b>	Students must consult with the Department Advisor in planning their studies.
<b>GRADUATION REQUIREMENT</b>	120 credit hours
Graduation G.P.A. Requirement	To graduate with a BSc Honours, students must have a minimum GPA of 3.0 on all major (Biology) courses which will be calculated on all course attempts in the major. A minimum 2.75 GPA on all non-major courses which will be calculated as for the General Degree (i.e., F's are not included and, in the case of repeated courses, only the highest grade will be used).
<b>RESIDENCE REQUIREMENT</b>	
Degree:	Minimum 60 credit hours
Honours:	Minimum 30 credit hours, including minimum 18 credit hours at upper level (3000/4000) of which a minimum of 9 credit hours at 4000 level
<b>GENERAL DEGREE REQUIREMENT</b>	
Humanities:	12 credit hours in Humanities
Writing:	Minimum 3 credit hours of Academic Writing.
Maximum Introductory Courses:	Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.
Distribution:	Minimum three (3) credit hours from each of five (5) different subjects.
<b>HONOURS REQUIREMENT</b>	
Single Honours:	Minimum 54 credit hours in the Major subject. Minimum 30 credit hours in upper-level (3000 and 4000) courses of which a minimum of 15 credit hours must be at the 4000 level.
Required Courses:	
<b>BIOL-1115(3)</b> Cells and Cellular Processes	
<b>BIOL-1116(3)</b> Evolution, Ecology and Biodiversity	
<b>BIOL-2301(3)</b> Genetics or the former <b>BIOL-3301(3)</b>	
<b>BIOL-2403(3)</b> Principles of Ecology (or the former <b>BIOL-3403(3)</b> or <b>BIOL-3902(3)</b> Microbial Ecology)	
<b>BIOL-3221(3)</b> Cell Biology	
<b>BIOL-4111(6)*</b> Biology Honours Thesis <b>*Note:</b> This course has admission restrictions, see course description.	
<b>CHEM-1111(3)</b> Introduction to Chemical Properties of Matter	

**CHEM-1112(3)** Basic Principles of Chemical Reactivity

6 credit hours of statistics selected from the following options:

STAT-1301(3) Statistical Analysis I and STAT-1302(3) Statistical Analysis II or the former STAT-1201(6) Introduction to Statistical Analysis

**OR** STAT-1501(3) Elementary Biological Statistics I **AND ONE OF** STAT-2001(3) Elementary Biological Statistics II **or** BIOL-3492(3) Quantitative & Theoretical Biology **or** BIOL-4471(3) Ecological Methods or the former STAT-1601(3) Elementary Biological Statistics II

**OR** GEOG-2309(3) Statistical Techniques in Environmental Analysis **AND ONE OF** BIOL-3492(3) Quantitative & Theoretical Biology **or** BIOL-4471(3) Ecological Methods

**OR** PSYC-2101(3) Introduction to Data Analysis **AND ONE OF** PSYC-2102(3) Introduction to Research Methods **or** BIOL-3492(3) Quantitative & Theoretical Biology **or** BIOL-4471(3) Ecological Methods

In addition to the above courses students must select a minimum of 33 credit hours from the Biology course offerings at or above the 2000 level **including**: 9 credit hours, selected from the 2000-level organismal courses [a minimum of 2 (two) kingdoms must be included]; 9 credit hours selected from the 4000-level courses in addition to **BIOL-4111(6)**.

As well, students must include in their Honours Program an **additional** minimum of 12 credit hours, at or above the 1000 level, selected from at least 2 (two) of the following departments: Chemistry, Physics, Mathematics, Statistics and Geography (Physical Geography courses only).

The following courses do not qualify:

CHEM-2801(3) Chemistry and Society, PHYS-1701(6) Astronomy, PHYS-2705(6) Cosmology: Science Fact to Science Fiction.

## REQUIREMENTS FOR THE UNIVERSITY OF WINNIPEG / RED RIVER COLLEGE 4-YEAR BSc (JOINT PROGRAM IN APPLIED BIOLOGY)

### INTRODUCTION

This is a joint degree program whereby students take courses at both institutions in a prescribed sequence. The program has been specifically designed to address the human resource needs of the health and environmental-based industries of Manitoba. Biotechnology is the area of emphasis in the Applied Biology program and the degree requirements are outlined below.

Students are required to complete courses at both institutions. Students will begin their program of study by completing 60 credit hours of course work at The University of Winnipeg. The next 30 credit hours are completed at Red River College and then students return to The University of Winnipeg to complete the final 30 credit hours. Students successfully completing the entire program will receive a joint degree parchment from The University of Winnipeg and Red River College. **N.B. Transfer of courses between institutions applies only to students who are officially in the joint program.**

### ADMISSION REQUIREMENT

Students must meet the entrance requirements for admission to The University of Winnipeg.

Application to the program in Applied Biology must be completed through the Admissions Office of The University of Winnipeg by March 1<sup>st</sup> in order to enter the program in September.

### GRADUATION REQUIREMENT

120 credit hours, that is, 90 credit hours meeting the requirements for the BSc General plus 30 additional credit hours.

### RESIDENCE REQUIREMENT

Degree:

Minimum 60 credit hours

Major:

Minimum 30 credit hours

### GENERAL DEGREE REQUIREMENT

Humanities:

12 credit hours in Humanities

Writing:

Minimum 3 credit hours of Academic Writing.

Maximum Introductory Courses:

Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.

Distribution:

Minimum three (3) credit hours from each of five (5) different subjects.

4-Year Program			
Year 1 - UW		Year 2 - UW	
BIOL-1115(3)	Cells and Cellular Processes	CHEM-2302(3)	Quantitative Chemical Analysis
BIOL-1116(3)	Evolution, Ecology and Biodiversity	CHEM-3302(3)	Methods of Chemical Analysis
CHEM-1111(3)	Intro to the Chemical Properties of Matter	CHEM-2202(3)	Organic Chemistry I
CHEM-1112(3)	Basic Principles of Chemical Reactivity	CHEM-2203(3)	Organic Chemistry II
ACS-1453(3)	Intro to Computers <b>OR</b>	BIOL-2301(3)	Genetics

ACS-1903(3) Programming Fundamentals 1 STAT-1501(3) Elementary Biological Statistics I RHET-1103(3) Academic Writing: Sciences 6 credit hours Humanities 3 credit hours Electives	BIOL-2902(3) Biology of the Prokaryotes & Viruses BIOL-3901(3) Microorganisms & Disease BIOL-3221(3) Cell biology - to be completed in Winter Term 3 credit hours Humanities 3 credit hours of electives
<b>Year 3 - RRC</b>	<b>Year 4 - UW</b>
ANIM-1030(3) Applied Microbiology CBST-1026(3) Gas Chromatography CBST-3001(6) Advanced Biochemistry CBST-1021(4) Molecular Biology CBST-1028(2) Immunology CBST-1029(7) Instrumentation CBST-1031(3) Introductory Biochemistry CBST-1033(3) Nutraceuticals CBST-1041(2) Regulatory Compliance CBST-1043(3) Tissue Culture	BIOL-2403(3) Principles of Ecology BIOL-4502(3) Molecular Cell Biology BIOL-4501(3) Developmental Biology CHEM-4502(3) Molecular Enzymology 6 credit hours chosen from: BIOL-3602(3) Comparative Animal Physiology I, BIOL-3603(3) Comparative Animal Physiology II, BIOL-3161(3) Vegetative Anatomy & Physiology of Seed Plants BIOL-3162(3) Reproductive Anatomy & Physiology of Seed Plants BIOL-4902(3) Microbial Physiology <b>NB: These courses have prerequisites that may not be included in the program. Consult a faculty advisor each year in planning your full program of study.</b> 3 credit hours of Humanities 9 credit hours of Electives

## **REQUIREMENTS FOR THE 3-YEAR BSc DEGREE OF THE UW/RRC COOPERATIVE AGREEMENT IN CHEMICAL AND BIOSCIENCES TECHNOLOGY**

In addition to the above program, The University of Winnipeg and Red River College (RRC) have a cooperative agreement for a program of studies designed to afford students the opportunity to obtain both the BSc General degree and the Diploma in Chemical and Biosciences Technology in four years, by allowing credit for work completed at the alternate institution.

**ADMISSION REQUIREMENT** Students must consult with a member of the Department in planning their course of study.

**GRADUATION REQUIREMENT** Minimum 60 credit hours

**RESIDENCE REQUIREMENT**  
Degree: Minimum 60 credit hours

**GENERAL DEGREE REQUIREMENT**  
 Humanities: 12 credit hours in Humanities  
 Required courses:  
 21 credit hours in Biology at the 2000 level or above, excluding **BIOL-4111(6)** Biology Honours Thesis.  
 Minimum 18 credit hours selected from at least 2 of the Departments of Chemistry, Geography (Physical Geography courses only), Mathematics, Physics, and Statistics, excluding **CHEM-2801(3)** Chemistry and Society; **PHYS-1701(6)** Astronomy; **PHYS-2705(3)** Cosmology: Science Fact to Science Fiction.

## **COURSE LISTINGS**

### **1000 LEVEL COURSES**

**Note:** Students must obtain credit in both **BIOL-1115(3)** and **BIOL-1116(3)** to satisfy the requirements for a major in Biology. Students can elect to take up to 6 additional credit hours in Biology at the 1000 level; however, these additional credit hours will not count towards the requirement for a major in Biology.  
 Students who wish to use **BIOL-1112(6)** (Human Anatomy and Physiology) as a prerequisite for advanced courses in Biology must obtain the permission of the Department Chair.

BIOL-1005(6) Concepts in Science  
 BIOL-1102(6) Biology and Human Concerns  
 BIOL-1103(6) Human Biology  
 BIOL-1106(3) Environmental Biology  
 BIOL-1112(6) Human Anatomy and Physiology

BIOL-1115(3) Cells and Cellular Processes  
 BIOL-1116(3) Evolution, Ecology and Biodiversity

### **2000 LEVEL COURSES**

BIOL-2111(6) Comparative Chordate Zoology  
 BIOL-2115(3) Biology of the Invertebrates  
 BIOL-2152(3) Introduction to Algae, Fungi and Mosses  
 BIOL-2153(3) Biology of Vascular Plants  
 BIOL-2301(3) Genetics  
 BIOL-2401(1) Forest Ecology Field Skills Course  
 BIOL-2403(3) Principles of Ecology  
 BIOL-2451(3) Introduction to Animal Behaviour  
 BIOL-2477(3) Forest Measurement  
 BIOL-2902(3) Biology of the Prokaryotes and Viruses

### 3000 LEVEL COURSES

**Note:** 3000-level courses may not be offered every year. Consult the current timetable for details.

BIOL-3112(3)	Ecology and Evolution of Mammals
BIOL-3152(3)	Flora of Manitoba
BIOL-3161(3)	Vegetative Anatomy and Physiology of Seed Plants
BIOL-3162(3)	Reproductive Anatomy and Physiology of Seed Plants
BIOL-3202(3)	Histology
BIOL-3221(3)	Cell Biology
BIOL-3303(3)	Molecular Genetics and Genomics
BIOL-3410(3)	Freshwater Ecology
BIOL-3452(3)	Behavioural Ecology and the Prairie Grasslands: Field Course
BIOL-3471(3)	Forest Ecology
BIOL-3473(3)	Principles of Silviculture
BIOL-3476(3)	Forest Policy and Management
BIOL-3492(3)	Quantitative and Theoretical Biology
BIOL-3562(3)	Human Reproductive Biology
BIOL-3563(3)	Human Embryology
BIOL-3602(3)	Comparative Animal Physiology I
BIOL-3603(3)	Comparative Animal Physiology II
BIOL-3702(3)	Parasites and Disease
BIOL-3703(3)	Ectoparasitology
BIOL-3801(3)	General Entomology
BIOL-3901(3)	Microorganisms and Disease
BIOL-3902(3)	Microbial Ecology

### THE FOLLOWING COURSES ARE NOT OFFERED EVERY YEAR:

BIOL-2477(3)	Forest Measurement
BIOL-3161(3)	Vegetative Anatomy and Physiology of Seed Plants
BIOL-3162(3)	Reproductive Anatomy and Physiology of Seed Plants
BIOL-3410(3)	Freshwater Ecology
BIOL-3473(3)	Principles of Silviculture
BIOL-3801(3)	General Entomology
BIOL-3902(3)	Microbial Ecology
BIOL-4112(3)	Ichthyology
BIOL-4402(3)	Current Topics in Ecology

### 4000 LEVEL COURSES

**Note:** 4000-level courses may not be offered every year. Consult the current timetable for details.

BIOL-4111(6)	Biology Honours Thesis
BIOL-4112(3)	Ichthyology
BIOL-4191(3)	Directed Studies in Biology
BIOL-4303(3)	Population Genetics
BIOL-4331(3)	Evolutionary Biology
BIOL-4402(3)	Current Topics in Ecology
BIOL-4411(3)	Water Quality and Health
BIOL-4451(2)	Forest Ecosystems Field Course
BIOL-4453(3)	Wetlands Ecosystems Field Course
BIOL-4471(3)	Ecological Methodology
BIOL-4473(3)	Dendrochronology: Principles and Applications
BIOL-4474(3)	Forest Health and Protection
BIOL-4475(3)	Urban Forestry
BIOL-4501(3)	Developmental Biology
BIOL-4502(3)	Molecular Cell Biology
BIOL-4601(3)	Ecological Animal Physiology
BIOL-4602(3)	Field Research in Animal Ecology and Energetics
BIOL-4902(3)	Microbial Physiology
BIOL-4904(3)	Virology
BIOL-4931(3)	Immunology

BIOL-4411(3)	Water Quality and Health
BIOL-4451(2)	Forest Ecosystems Field Course
BIOL-4453(3)	Wetlands Ecosystems Field Course
BIOL-4471(3)	Ecological Methodology
BIOL-4473(3)	Dendrochronology: Principles and Applications
BIOL-4474(3)	Forest Health and Protection
BIOL-4475(3)	Urban Forestry
BIOL-4601(3)	Ecological Animal Physiology
BIOL-4902(3)	Microbial Physiology
BIOL-4904(3)	Virology
BIOL-4931(3)	Immunology

## COURSE DESCRIPTIONS

**BIOL-1005(6) CONCEPTS IN SCIENCE (Le6)** This course explores science at a qualitative level from this interdisciplinary viewpoint, with an aim to foster scientific literacy and develop critical thinking skills that are so crucial in today's society. Topics are drawn from biology, chemistry, geography, and physics, and range from the large - the universe, the earth, and ecosystems - to the small - cells, molecules, and atoms. Emphasis is placed on the unifying concepts running through such diversity, with activities and demonstrations forming an integral component. The course fulfills the Science requirement.

**CROSS-LISTED:** PHYS-1005(6) and MULT-1005(6)

**Note:** Students must obtain credit in both BIOL-1115(3) and BIOL-1116(3) to satisfy the requirements for a major in Biology. Students can elect to take up to 6 additional credit hours in Biology at the 1000 level; however, these additional credit hours will not count towards the requirement for a major in Biology. Students who wish to use BIOL-1112(6) (Human Anatomy and Physiology) as a prerequisite for advanced courses in Biology must obtain the permission of the Department Chair.

### BIOL-1102(6) BIOLOGY AND HUMAN CONCERNS (Le3)

This course deals with the chemistry of life, cellular structure and function, genetics, natural ecosystems, impact of human populations and activities, food and water safety issues, consumer health awareness, global and Manitoban environmental concerns.

**BIOL-1103(6) HUMAN BIOLOGY (Le3)** This course deals with the fundamental principles of anatomy, physiology, reproduction, and development. It deals with biological theories and practices using humans as the principal example.

**BIOL-1106(3) ENVIRONMENTAL BIOLOGY (Le3)** This course will provide students with an understanding of the interrelationship of living organisms with each other and with their environment. The course will examine the following: the biological basis of environmental damage caused by human population growth; the use and depletion of resources; pollution; and ways in which environmental problems can be minimized.

**RESTRICTIONS:** BIOL-1106(3) may be used towards fulfilling the science requirement for the BA degree. This course



cannot be used to fulfill the requirements for the Biology major.

**Note:** Students must obtain credit in both BIOL-1115(3) and BIOL-1116(3) to satisfy the requirements for a major in Biology. Students can elect to take up to 6 additional credit hours in Biology at the 1000 level; however, these additional credit hours will not count towards the requirement for a major in Biology. Students who wish to use BIOL-1112(6) (Human Anatomy and Physiology) as a prerequisite for advanced courses in Biology must obtain the permission of the Department Chair.

#### **BIOL-1112(6) HUMAN ANATOMY AND PHYSIOLOGY**

**(Le3, La3)** This course deals with the biological study of the human organism; microscopic and gross anatomy; cellular and general physiology, and human genetics. This course is a prerequisite for the Degree program in Athletic Therapy. It is also a required component of the R.N. programs of several local hospitals. It can be taken by regular students to satisfy the Science Requirement.

**Students who wish to use this course as a prerequisite for advanced courses in Biology must obtain the permission of the Department Chair.**

**Note:** Students must obtain credit in both BIOL-1115(3) and BIOL-1116(3) to satisfy the requirements for a major in Biology. Students can elect to take up to 6 additional credit hours in Biology at the 1000 level; however, these additional credit hours will not count towards the requirement for a major in Biology. Students who wish to use BIOL-1112(6) (Human Anatomy and Physiology) as a prerequisite for advanced courses in Biology must obtain the permission of the Department Chair.

**Note:** Students with standing in BIOL-1112(6) are not allowed to register or receive credit for KIN-2204(3).

#### **BIOL-1115(3) CELLS AND CELLULAR PROCESSES (Le3, La3)**

This course will focus on the structural components, biochemistry, and physiology of cells. Topics to be covered will include structure and function of macromolecules, introduction to metabolism, cells and cell structure, cellular respiration, photosynthesis, mitosis and meiosis, life cycles, Mendelian genetics, chromosomes and heredity, DNA structure and replication, transcription and translation, and DNA technology. The laboratory component of this course will both supplement and support the lecture material. The course is designed for students who intend to (a) major in Biology, (b) take a teaching Major or Minor in Biology in the BEd program, (c) take a BSc in Environmental Studies, or (d) take a BA in the B stream of Developmental Studies.

**PREREQUISITES:** Pre-Calculus Mathematics 40S or Applied Mathematics 40S and Chemistry 40S. Students who have credit in one of Chemistry 40S and Pre-Calculus Mathematics 40S, but not in both, may, under certain conditions, qualify to register in this course.

**RESTRICTIONS:** Students may not receive credit for this course and the former BIOL-1111(6).

**Note:** Cells and Cellular Processes is a prerequisite for all 2000-, 3000- and 4000-level courses in Biology. It is also a required course for entry to Agriculture, Dentistry, Human Ecology, Medical Rehabilitation, Nursing Education, Optometry, Pharmacy, and Veterinary Medicine.

**Note:** Students must obtain credit in both BIOL-1115(3) and BIOL-1116(3) to satisfy the requirements for a major in Biology. Students can elect to take up to 6 additional credit hours in Biology at the 1000 level; however, these additional credit hours will not count towards the requirement for a major in Biology. Students who wish to use BIOL-1112(6) (Human Anatomy and Physiology) as a prerequisite for advanced courses in Biology must obtain the permission of the Department Chair.

#### **BIOL-1116(3) EVOLUTION, ECOLOGY AND**

**BIODIVERSITY (Le3, La3)** This course surveys evolution,

ecology and biodiversity. Specific topics include evolutionary mechanisms, microevolution, speciation, phylogeny, systematics, eukaryote and prokaryote diversity, behavioural, population, community and ecosystem ecology, and conservation biology. The laboratory emphasizes the diversity of living organisms.

**PREREQUISITES:** Pre-Calculus Mathematics 40S or Applied Mathematics 40S and Chemistry 40S. Students who have credit in one of Chemistry 40S and Pre-Calculus Mathematics 40S may, under certain conditions, qualify to register in this course.

**RESTRICTIONS:** Students may not receive credit for this course and the former BIOL-1111(6).

**Note:** Evolution, Ecology and Biodiversity is a prerequisite for all 2000, 3000, and 4000-level courses in Biology. It is also a required course for entry to Agriculture, Dentistry, Human Ecology, Medical Rehabilitation, Nursing Education, Optometry, Pharmacy, and Veterinary Medicine.

**Note:** Students must obtain credit in both BIOL-1115(3) and BIOL-1116(3) to satisfy the requirements for a major in Biology. Students can elect to take up to 6 additional credit hours in Biology at the 1000 level; however, these additional credit hours will not count towards the requirement for a major in Biology. Students who wish to use BIOL-1112(6) (Human Anatomy and Physiology) as a prerequisite for advanced courses in Biology must obtain the permission of the Department Chair.

#### **BIOL-2111(6) COMPARATIVE CHORDATE ZOOLOGY**

**(Le3,La3)** This course deals with the functional anatomy, adaptations, and evolution of the Protochordata, Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6).

#### **BIOL-2115(3) BIOLOGY OF THE INVERTEBRATES (Le3,**

**La3)** This course provides a synopsis of the major taxa of invertebrates to demonstrate the richness in diversity of this dominant sub-group of animals and to illustrate their importance to the functioning of natural ecosystems. Major aspects of invertebrate biology that distinguish invertebrates from and unite them with other taxa are considered in detail. The major biological pillars - anatomy, physiology, behaviour, ecology and evolution - are emphasized from a systems approach with appropriate, comparative examples drawn from different invertebrate groups to explain how disparate animal groups solve similar survival and reproductive problems posed by a common environment.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6).

**RESTRICTIONS:** Students may not hold credit in this course and BOTH of the former BIOL-2113(3) and BIOL-2114(3). Students holding credit for one of the BIOL-2113(3) or BIOL-2114(3) should see the Instructor or the Department Chair for permission to register.

#### **BIOL-2152(3) INTRODUCTION TO ALGAE, FUNGI AND**

**MOSSES (Le3,La3)** This course provides an introduction to the morphology, life histories, evolution and ecology of the algae, fungi, mosses and their allies. Emphasis will be placed on local organisms. The laboratory work is a major component of the course.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6).

**RESTRICTIONS:** Students may not hold credit for BIOL-2152(3) and the former BIOL-2151(6).

#### **BIOL-2153(3) BIOLOGY OF VASCULAR PLANTS (Le3,**

**La3)** This course explores the evolution and ecology of the nine extant groups of vascular plants. Their success in ancient and contemporary environments is examined

through consideration of structural diversity, life history, and reproductive biology. Emphasis will be placed on local flora.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6).

**RESTRICTIONS:** Students may not hold credit for BIOL-2153(3) and the former BIOL-2151(6).

**BIOL-2301(3) GENETICS (Le3, La3)** Genetics is central to the study of Biology. It deals with the processes of heredity at all levels, from molecules to populations. Genetic analysis is a logical process; the steps we use today are much the same as those employed by Mendel. Genetic phenomena are analyzed using chemical, biochemical, mathematical, and physical techniques. This course will give you an understanding of the subject as a whole and provide you with a sound basis for evaluating contemporary issues such as genetic engineering, environmental mutagens, heritable human diseases etc. Topics to be covered will include: extensions to Mendelian analysis, mapping techniques, gene mutation, the effects of changes in chromosome number and chromosome structure, the genetics of bacteria and their viruses, the nature of the gene, recombinant DNA technology, and population genetics.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3) or the former BIOL-1111(6).

**RESTRICTIONS:** Students may not hold credit for both BIOL-2301(3) and the former BIOL-3301(3).

#### **BIOL-2401(1) FOREST ECOLOGY FIELD SKILLS**

**COURSE (La1)** This intensive two-week field course is mandatory for students in the Forest Ecology program and is designed to give students field survival and basic forestry skills. Topics include bush camp construction; safe use of boats, ATV's, and chain saws; and basic bush survival skills. Students also learn how to correctly use topographical maps, compasses, air photos, GIS maps and other forestry equipment. This course is offered at Keewatin Community College at The Pas, Manitoba.

**PREREQUISITES:** This course is also listed as KC.RRR.1200/1 in the KCC general calendar.

**CROSS-LISTED:** Environmental Studies ENV-2401/1.

**BIOL-2403(3) PRINCIPLES OF ECOLOGY (Le3, La3)** This course is concerned with general concepts in ecology.

Topics covered will include energy flow, biochemical cycles, populations, communities, and human ecology.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6).

**RESTRICTIONS:** Students may not hold credit for both BIOL-2403(3) and the former BIOL-3403(3) or BIOL-3402(6).

#### **BIOL-2451(3) INTRODUCTION TO ANIMAL BEHAVIOUR**

**(Le3)** This course provides an introduction to the evolutionary basis of animal behaviour, covering such topics as the relationship between genes and behaviour, communication, foraging, locomotion, mating behaviour, and the social interactions that contribute to the biological success of animals. Each of the major topics is outlined with respect to cost and benefits of different behaviours within particular ecological contexts and explicit examples are drawn from different animal taxa to illustrate the concepts. The course is expected to provide a foundation and context for other related disciplines in biology, especially physiology and ecology, and to illustrate how behaviours function to solve problems for animals.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3) or BIOL-1102(6)

**BIOL-2477(3) FOREST MEASUREMENT (Le3)** Students study the various methods, techniques, and statistical approaches to measuring tree growth and assessing forest inventory. This course examines individual tree growth and measurement (growth and yield) and the measurement of

standing and harvested trees from an inventory and volume perspective.

**COREQUISITES:** GEOG-2309(3), or STAT-1301(3) or STAT-1501(3), or PSYC-2101(3), or the former STAT-1201(6) or permission of the instructor.

**RESTRICTIONS:** This course is intended for students enrolled in the Forest Ecology Program in Environmental Studies. Students not in this program but wishing to take this course need the permission of the instructor.

**BIOL-2902(3) BIOLOGY OF THE PROKARYOTES AND VIRUSES (Le3, La3)** This course provides an introduction to the morphology, physiology and biochemistry of the major groups of prokaryotes and viruses. Emphasis will be placed on examining the fundamental principles and methods used in culturing, characterizing, and classifying of bacteria.

**PREREQUISITES:** BIOL-1115(3), BIOL-1116(3), CHEM-1111(3), and CHEM-1112(3), or the former BIOL-1111(6) and CHEM-1101(6).

**RESTRICTIONS:** Students may not hold credit for BIOL-2902(3) and the former BIOL-2901(6).

#### **BIOL-3112(3) ECOLOGY AND EVOLUTION OF MAMMALS (Le3,La3)**

The ecology and evolution of living mammals is examined by considering aspects of their evolutionary history, behaviour and ecology, drawing comparisons with other vertebrate groups. Lab exercises expose students to a variety of methods used in research on mammals (e.g., analysis of carnivore diet, acoustic analysis, behavioural research, radio-telemetry). Guest presentations and field trips expose students to opportunities for professional work with mammals and other vertebrates (e.g., work in wildlife biology, zoos, provincial or federal parks).

**PREREQUISITES:** BIOL-2403(3) and BIOL-2111(6) or BIOL-2451(3).

**BIOL-3152(3) FLORA OF MANITOBA (Le3,La3)** Because knowledge of the flora of Manitoba is essential to field biologists, this course includes discussion of the origin and present composition of the Manitoba flora, identification, description, collection, nomenclature, classification, and evolutionary relationships of plants. Laboratory work consists of examination of the more important plant families and habitats in the province.

**PREREQUISITES:** BIOL-2153(3) or the former BIOL-2151(6). Students are required to submit a mounted and identified collection of plants as part of the laboratory exercises. This collection should be initiated in the summer preceding registration in the course. Students should contact the Instructor for further details.

**BIOL-3161(3) VEGETATIVE ANATOMY AND PHYSIOLOGY OF SEED PLANTS (Le3)** The course involves an integrated study of the structure and function of the vegetative parts of seed plants. It will include study of the structure and organization of cells and tissues as well as the development and function of these structures.

**PREREQUISITES:** BIOL-2153(3) or the former BIOL-2151(6).

**BIOL-3162(3) REPRODUCTIVE ANATOMY AND PHYSIOLOGY OF SEED PLANTS (Le3)** The course involves a study of the reproductive structure of seed plants, including their anatomy, development, control mechanisms in the flowering and fruiting process, and the physiology of the various flower parts and fruit parts.

**PREREQUISITES:** BIOL-3161(3).

**BIOL-3202(3) HISTOLOGY (Le3, La3)** This course examines the microscopic structure of vertebrate tissues and organs, with stress on mammalian histology. Consideration is also given to structure-function relationships.



**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6).

**RESTRICTIONS:** Students may not hold credit for both BIOL-3202(3) and the former BIOL-2202(3).

**BIOL-3221(3) CELL BIOLOGY (Le3, La3)** This course examines the ultrastructure of cells and sub-cellular organelles. The study includes the interrelationship of structure and function, cellular biochemistry, bioenergetics, and cellular differentiation.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6). Students are advised not to attempt this course unless they have obtained a grade of at least C in CHEM-2202(3) and CHEM-2203(3) or the former CHEM-2201(6).

**BIOL-3303(3) MOLECULAR GENETICS AND GENOMICS (Le3, La3)** This course deals with basic genetic techniques and phenomena at the molecular level. Topics covered include transcription, translation and the genetic code, regulation of gene expression in prokaryotes and eukaryotes, recombinant DNA technology and its applications, genomics, manipulation of sequence database information and sequence data analysis.

**PREREQUISITES:** BIOL-2301(3)

**RESTRICTIONS:** Students may not hold credit for this course and the former BIOL-4302(3).

**BIOL-3410(3) FRESHWATER ECOLOGY (Le3, La3)** This course examines the environmental and biotic processes which operate in aquatic environments. Special emphasis is placed on Manitoba ecosystems. Topics covered include the following: water quality, physical and chemical processes operating in freshwaters, and an overview of freshwater organisms that constitute aquatic communities.

**PREREQUISITES:** BIOL-2403(3) or the former BIOL-3403(3) or BIOL-3402(6).

**RESTRICTIONS:** Students may not hold credit for this course and the former BIOL-4410(3).

**BIOL-3452(3) BEHAVIOURAL ECOLOGY AND THE PRAIRIE GRASSLANDS: FIELD COURSE (Le3, V)**

This course focuses on the ecology, evolution and behaviour of animals living in grassland habitats. Students develop basic field skills and familiarity with the scientific process while addressing questions about predation, social behaviour, parental care and communication in species as diverse as rattlesnakes, bison, nesting hawks and mule deer. The course takes place at three significant prairie sites: the tall grass prairie of Manitoba, Grasslands National Park in Saskatchewan, and the McIntyre Ranch in Alberta. Students need to be prepared to live and work outside in a variety of weather conditions.

**PREREQUISITES:** BIOL-2403/3 OR BIOL-2451/3 AND 1 OF EITHER STAT-1201/6, STAT-1501/3, GEOG-2309/3 OR PSYC-2101/3

**BIOL-3471(3) FOREST ECOLOGY (Le3)** This course provides an integrative, interdisciplinary discussion on structure and function of forest ecosystems, with a special reference to boreal forests in North America. Topics to be covered will include the following: the concept of ecosystem studies; global and local variations in forest type; forest ecosystem classification; processes controlling ecosystem structure and function; disturbances, succession, and ecosystem function of boreal forests; and computer modelling in ecosystem studies.

**PREREQUISITES:** BIOL-2403(3) or the former BIOL-3403(3) or **GEOG-2213(3) (Introductory Soil Science) and GEOG-2214(3) (Soil-Vegetation Systems)**..

**BIOL-3473(3) PRINCIPLES OF SILVICULTURE (Le3)** This course integrates biological principles of tree growth and

regeneration (silvics) with the application of this knowledge to forest management (silviculture). Silvics is defined as biological life histories and environmental requirement of forest trees. Silviculture is the theory and practice of influencing forest regeneration, species composition, and growth to accomplish a variety of resource management objectives. Silvicultural practices include coverage of even-aged and uneven-aged management, and ecological reforestation principles and techniques.

**PREREQUISITES:** BIOL-2153(3) and BIOL-2403(3).

**RESTRICTIONS:** Students may not hold credit for this course and the former BIOL-3472(3).

**BIOL-3476(3) FOREST POLICY AND MANAGEMENT**

**(Le3)** This course focuses on the principles and practices of sustainable forestry in Canada. It outlines the evolution of the Canadian forest industry, examining past and current forestry policy, practices, and legal frameworks. Topics include harvesting, reforestation, forest protection, private woodlot forestry, and speciality products, as well as the acts, regulations, codes, and guidelines which govern these aspects of forestry. The course examines the place of Canadian forestry within the larger context of multi-resource management, multi-stakeholder processes, and the global market. The environmental impact of forest management activities on the landscape is examined in light of ever changing environmental codes and restrictions and the need to produce "green products."

**RESTRICTIONS:** Students may not hold credit for BIOL-3476(3) and the former BIOL-4476(3).

**CROSS-LISTED:** Environmental Studies ENV-3476(3).

**BIOL-3492(3) QUANTITATIVE AND THEORETICAL**

**BIOLOGY (Le3)** This course explores quantitative and theoretical biology. Topics include the relationship of theory to data, hypothesis testing, spreadsheet modelling, bootstrapping and other resampling methods.

**PREREQUISITES:** BIOL-2301(3) and BIOL-2403(3)

**BIOL-3562(3) HUMAN REPRODUCTIVE BIOLOGY**

**(Le3,T1)** This course presents a comprehensive overview of the biology of human sex and reproduction including the anatomy and physiology of the male and female reproductive systems, sexual response, fertilization, contraception, and sexually transmitted diseases. It provides the biological background required for critical evaluation of many current issues surrounding human reproduction and sexuality. Tutorial times will be used for the presentation of additional course information and supplemental activities such as class presentations, peer-editing exercises, videos and group projects.

**PREREQUISITES:** One of BIOL-1102(6), BIOL-1103(6), BIOL-1112(6) or BIOL-1115(3) and BIOL-1116(3).

**RESTRICTIONS:** Students may not hold credit in this course and the former BIOL-3561(6).

**BIOL-3563(3) HUMAN EMBRYOLOGY (Le3)**

This course provides a comprehensive overview of the structural, functional and developmental anatomy of the human body. Consideration is given to the important events of the first three weeks of development. The normal development of several organ systems including the urogenital, cardiovascular, respiratory and digestive is examined as well as examples of abnormalities that may arise.

**PREREQUISITES:** One of BIOL-1102(6), BIOL-1103(6), BIOL-1112(6) or BIOL-1115(3) and BIOL-1116(3).

**RESTRICTIONS:** Students may not hold credit in this course and the former BIOL-3561(6).

**BIOL-3602(3) COMPARATIVE ANIMAL PHYSIOLOGY I**

**(Le3, La3)** This course introduces the concepts of physiological homeostasis, physiological control systems and

excitable cells. Principal topics are nerve physiology, muscle physiology and cardiovascular physiology.  
**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6). It is strongly recommended that students successfully obtain standing in CHEM-1111(3) and CHEM-1112(3), or the former CHEM-1101(6), before attempting this course.

**RESTRICTIONS:** Students may not hold credit for this course and the former BIOL-3601(6).

### **BIOL-3603(3) COMPARATIVE ANIMAL PHYSIOLOGY II**

**(Le3, La3)** This course continues the study of animal physiology. Principal topics are respiratory physiology, whole animal metabolism, osmoregulation, digestion and endocrine physiology.

**PREREQUISITES:** BIOL-3602(3) or permission of the instructor.

**RESTRICTIONS:** Students may not hold credit for this course and the former BIOL-3601(6).

**BIOL-3702(3) PARASITES AND DISEASE (Le3,La3)** This course provides a synopsis of the major taxa of parasites that inhabit tissues and organs of metazoan animals and a detailed consideration of the biology of organisms that reside within other organisms as parasites. Some of the course deals with clinical manifestations and treatment of endoparasitic infections as well as the use of knowledge about life cycles for the design of effective programs of control and intervention. The synopsis of major taxa is structured to emphasize diversity of endoparasitic organisms and to demonstrate their importance as limiting, biological factors for their hosts.

**PREREQUISITES:** BIOL-2115(3) or the former BIOL-2113(3), or permission of the instructor.

**RESTRICTIONS:** Students may not hold credit in this course and the former BIOL-3701(6).

**BIOL-3703(3) ECTOPARASITOLOGY (Le3,La3)** This course provides a synopsis of the major taxa of parasites and blood-feeding arthropods that live on other metazoan animals and a detailed consideration of the ways in which these organisms act directly as parasites and as vectors of other parasitic organisms. Emphasis is placed on ecological associations between host organisms and parasites as a means of understanding the epidemiology of vector-borne, parasitic diseases. Most of the course deals with the biology of parasitic arthropods as well as the use of biological information about life cycles to consider effective means of control and intervention. The synopsis of major taxa is structured to emphasize diversity of ectoparasitic organisms as a means of demonstrating the significant evolutionary success of the blood-feeding habit.

**PREREQUISITES:** BIOL-2115(3) or the former BIOL-2114(3), or permission of the instructor.

**RESTRICTIONS:** Students may not hold credit in this course and the former BIOL-3701(6).

**BIOL-3801(3) GENERAL ENTOMOLOGY (Le3, La3)** The course deals with the life history, structural and behavioral adaptations, the economic effects of insects, and insect control. The laboratory period will include the collection, preservation, dissection and identification of insects.

**PREREQUISITES:** BIOL-2115(3) or the former BIOL-2114(3).

**Note:** Students are required to submit a mounted and identified collection of insects as part of the laboratory exercises. This collection should be initiated in the summer preceding registration in the course. Students should contact the instructor for further details.

**BIOL-3901(3) MICROORGANISMS AND DISEASE (Le3, La3)** The course will include a study of medically important microorganisms with emphasis on viruses and bacteria, including chlamydiae, mycoplasmas, and rickettsias. Topics

to be covered will include mechanisms of microbial pathogenicity and virulence; the etiology and epidemiology of important human pathogens; public health and nosocomial infections; antimicrobial agents and chemotherapy; and basic principles of host defence mechanisms. Attention will also be paid to diseases of important animal species and to plants of economic importance.

**PREREQUISITES:** BIOL-2902(3) and CHEM-1111(3) and CHEM-1112(3), or the former CHEM-1101(6).

**RESTRICTIONS:** Students may not hold credit for this course and the former BIOL-2901(6).

**BIOL-3902(3) MICROBIAL ECOLOGY (Le3)** This course examines the ecologically important activities of microorganisms, including interactions between microorganisms, plants, and animals; the cycling of carbon, nitrogen, sulphur, and phosphorus through terrestrial and aquatic ecosystems; bio-deterioration; soil, waste, and water management; resource recovery; fuel and biomass production; biological pest control; microbial transformation of man-made organic chemicals; and bio-remediation.

**PREREQUISITES:** BIOL-2902(3), or the former BIOL-2901(6).

**RESTRICTIONS:** Students may not hold credit for this course and the former BIOL-4901(3).

**BIOL-4111(6) BIOLOGY HONOURS THESIS (P)** This course is intended for but not restricted to students in the Honours program. Students undertake a research project in an area of biological interest. Presentation of the results verbally and in thesis form to the Biology Department is an integral part of the course. Each project will be supervised by a faculty member.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3), or the former BIOL-1111(6); 24 credit hours offered by the Department at or above the 2000 level; at least 3 credit hours in Statistics or Data Analysis, a minimum GPA of 3.0 in Biology and a minimum overall GPA of 2.75, or permission of the Department Chair.

**Note:** Enrolment in this course is limited by the availability of faculty to serve as supervisors. Students must obtain written permission from the Department Chair to register for the course. A written agreement between the student and the faculty supervisor is required before permission will be granted.

**BIOL-4112(3) ICHTHYOLOGY (Le3, La3)** This course is concerned with the morphology, ecology, evolution, and distribution of fishes. Human interaction with fishes and conservation and management of fish stocks are also discussed. Fishes and the management of fish stocks in Manitoba and Canada are emphasized.

**PREREQUISITES:** BIOL-2111(6).

**BIOL-4191(3) DIRECTED STUDIES IN BIOLOGY (D)** This course allows students to undertake research in their areas of interest. The research may take the form of a literature review, it may be experimental in nature, or it may involve analysis of existing data. Evaluation is based on an extensive written report summarizing the student's findings. Permission to enrol is dependent on the availability of an instructor in the student's field of interest. A student may receive credit for this course only once.

**PREREQUISITES:** BIOL-1115(3) and BIOL-1116(3) and four other Biology courses or, if not a major, BIOL-1115(3), BIOL-1116(3) and a degree in another discipline or permission of instructor.

**BIOL-4303(3) POPULATION GENETICS (Le3)** This course covers the basics of detection and quantification of genetic variation in natural populations, and how genetic variation is affected by mutation, recombination, migration, mating patterns and changes in population size. Students are

introduced to the theories of the maintenance of genetic variation by exploring natural selection *versus* genetic drift and how these forces affect the genetic variability of populations. Examples of the application of population genetics principles in the areas of conservation biology, evolution and human health are illustrated. The final part of the course is dedicated to the application of population genetics principles in the analysis of actual DNA and protein data.

**PREREQUISITES:** BIOL-2301(3) or the former BIOL-3301(3)

**BIOL-4331(3) EVOLUTIONARY BIOLOGY (Le3)** Biologists use Darwin's framework to study the living world. This course will examine the development of evolutionary thought; evolutionary genetics; natural, sexual, and developmental selection; the levels of selection; speciation and extinction. Topics of direct relevance to humans will be emphasized.

**PREREQUISITES:** BIOL-2301(3) or the former BIOL-3301(3), BIOL-2403(3) or the former BIOL-3403(3) and at least three credits chosen from BIOL-2111(6), BIOL-2115(3), BIOL-2152(3), BIOL-2153(3) or the former BIOL-2113(3), the former BIOL-2114(3).

**RESTRICTIONS:** Students may not hold credit for this course and the former BIOL-3331(3).

**BIOL-4402(3) CURRENT TOPICS IN ECOLOGY (Le3)** This course involves students in current issues and topics in ecology. The Instructor supplies a range of potential topics from which students can select ones of interest. Students may also offer their own topics for presentation. Students present a review of their topic to the class in the form of a seminar. Success in the course depends on substantial class participation and will involve peer assessment and review.

**PREREQUISITES:** BIOL-2403(3) and any one of: BIOL-3471(3), BIOL-3902(3); or permission of the instructor.

**BIOL-4411(3) WATER QUALITY AND HEALTH (Le3, La3)**

This course deals with inorganic, organic, and biotic components of water which affect water quality. The impacts on aquatic ecosystems and on recreational, industrial, and agricultural uses are studied. The greatest emphasis is on drinking water quality as it relates to public health and water-borne illness.

**PREREQUISITES:** BIOL-1115(3), BIOL-1116(3), and both of CHEM-1111(3) and CHEM-1112(3) or the former CHEM-1101(6). Recommended: CHEM-2202(3) and CHEM-2203(3) or the former CHEM-2201(6).

**BIOL-4451(2) FOREST ECOSYSTEMS FIELD COURSE**

**(P, V)** This is an intensive three-week field course designed to give students a comprehensive overview of forest ecology field skills. Topics include field and laboratory exercises in boreal and urban forestry; tree and plant identification; classification of forest types; forest management and environmental impact; soil classification; forest succession; dendrochronology; forest measurement; forest protection and silviculture.

**PREREQUISITES:** BIOL-2153(3) and BIOL-2403(3).

**RESTRICTIONS:** This course is intended for students enrolled in the Forest Ecology Program in Environmental Studies. Students not in this program but wishing to take this course need the permission of the instructor.

**BIOL-4453(3) WETLANDS ECOSYSTEMS FIELD**

**COURSE (NT)** This course deals with the methods for studying the ecology of lakes, rivers and streams, and marshes: three major freshwater habitats found in Manitoba. Students will examine the methods for sampling and analyzing data on the chemical, physical, and biological components of these habitats. The adaptations of animals and plants to freshwater ecosystems will be emphasised.

**PREREQUISITES:** BIOL-2403(3), or the former BIOL-3403(3) or BIOL-3402(6).

**BIOL-4471(3) ECOLOGICAL METHODOLOGY (Le3, La3)**

This course is concerned with ecological methodology as well as the use of computers to analyze, interpret, and present ecological data. Topics to be covered will include the following: the nature and properties of measurements; graphic presentation, statistical analysis, and ecological interpretation of data; sampling and experimental design; and selected methodologies in studying forest ecosystems.

**PREREQUISITES:** One of GEOG-2203(6), BIOL-2403(3) or BIOL-3471(3) and one of STAT-1301(3), STAT-1501(3), GEOG-2309(3), GEOG-2310(3) or BIOL-3492(3) or permission of instructor.

**BIOL-4473(3) DENDROCHRONOLOGY: PRINCIPLES AND APPLICATIONS (Le3, La3)**

This course constitutes an introduction to dendrochronology; the science of tree-ring analysis. Dendrochronology is particularly appropriate for students with interests in the chronological and dynamical aspects of tree growth, forest ecology, climatology, hydrology, geomorphology, and anthropology/archaeology. The history, principles and applications of dendrochronology are reviewed in this course. Problems related to the sampling and dating of tree-ring series; the development of chronological series, the analysis and interpretation of dendrochronological data are also emphasized. This course includes a compulsory field trip during the second or third weekend of the course.

**PREREQUISITES:** BIOL-2403(3) or the former BIOL-3403(3) and BIOL-2153(3) or permission of the instructor.

**BIOL-4474(3) FOREST HEALTH AND PROTECTION (Le3)**

This course focuses on the effect of fire, insect, disease, and abiotic disturbances on the sustainable management of commercial forests in Canada. The course covers historic practices, current activities, and future trends in protecting commercial forests and ensuring the integrity of forest ecosystems. Emphasis is placed upon the impact of forest health activities on the general ecological components of forest systems and the relationship between forest succession. The evolution of Canadian forestry protection policy and industry regulation is also examined.

**PREREQUISITES:** BIOL-2115(3) or the former BIOL-2114(3) and BIOL-2153(3) OR permission of instructor.

**BIOL-4475(3) URBAN FORESTRY (Le3, LaV)**

This course focuses on the biology, ecology, and management of urban forests. Students examine the impact of both natural and human-induced stresses on the urban forest, including forest protection and enhancement in relation to other competing interests in the urban environment. The evolution of urban forest planning and management are discussed and the role of Canadian policies and regulations in influencing urban forest tree species and integration of urban forests into our communities are studied.

**PREREQUISITES:** BIOL-2115(3) or the former BIOL-2114(3) and BIOL-2153(3) OR permission of instructor.

**BIOL-4501(3) DEVELOPMENTAL BIOLOGY (Le3, La3)**

This course examines the molecular basis of, and the regulatory mechanisms involved in, cellular differentiation, the interaction of cells during the formation of tissues, growth, and aging in animal development.

**PREREQUISITES:** BIOL-3221(3). Recommended: BIOL-2301(3) (or the former BIOL-3301(3)), and CHEM-3502(3) and CHEM-3503(3) (or the former CHEM-3501(6)).

**BIOL-4502(3) MOLECULAR CELL BIOLOGY (Le3)**

Topics to be covered will include the following: cell signalling; the cytoskeleton, extracellular matrices and cell adhesion; the cell division cycle; apoptosis and cell death; the immune

system and the genetic basis of cancer. Instruction will involve lectures and discussion; students will be required to write a paper and present a seminar based on a review of the primary research literature.

**PREREQUISITES:** BIOL-2301(3) or the former BIOL-3301(3), BIOL-3221(3) and CHEM-3502(3) and CHEM-3503(3) or the former CHEM-3501(6).

**COREQUISITES:** BIOL-3303(3) or the former BIOL-3302(3) or BIOL-4302(3).

### **BIOL-4601(3) ECOLOGICAL ANIMAL PHYSIOLOGY (Le3)**

This course considers physiological adaptations of animals, primarily non-mammalian vertebrates and invertebrates, to their environments. It examines short term adaptations to specific environmental stressors, and physiological strategies associated with long term adaptation to particular ecological niches.

**PREREQUISITES:** CHEM-1111(3) and CHEM-1112(3), or the former CHEM-1101(6) and any one of BIOL-2111(6), BIOL-3602(3) and BIOL-3603(3) or the former BIOL-3601(6) or CHEM-3502(3) and CHEM-3503(3) or the former CHEM-3501(6).

### **BIOL-4602(3) FIELD RESEARCH IN ANIMAL ECOLOGY AND ENERGETICS (P,V)**

This course covers field and laboratory methods for studying ecological energetics and evolutionary physiology of free-ranging wild animals. During a field camp before the start of fall term, students learn techniques for studying metabolism and energy balance in animals including small mammal trapping/identification, temperature radiotelemetry, and open-circuit respirometry. The course focuses on small mammals, but there are opportunities to study songbirds, and some non-endothermic vertebrates and invertebrates. Each student conducts an independent research project during the field camp, and presents this work in a seminar and term paper during fall term.

**PREREQUISITES:** BIOL-2403 (3), BIOL-2451 (3), BIOL-3602 (3), BIOL-3603 (3), or BIOL-3492 (3). A minimum of 15 credit hours in Biology at or above the 2000 level.

**BIOL-4902(3) MICROBIAL PHYSIOLOGY (Le3)** This course examines the principal reactions of the energy and biosynthetic metabolism of bacteria using *Escherichia coli* as the model system. Additional topics to be discussed include metabolic diversity and catabolic activities of aerobic heterotrophs; regulation of bacterial metabolism; bacterial fermentations; chemolithotrophic and phototrophic metabolism, and fixation of molecular nitrogen.

**PREREQUISITES:** BIOL-2902(3) and BIOL-3901(3), or the former BIOL-2901(6), CHEM-3502(3) and CHEM-3503(3) or the former CHEM-3501(6) or permission of instructor.

**BIOL-4904(3) VIROLOGY (Le3)** This course examines variations in viral architecture; molecular processes that characterise the common steps of the reproductive cycles of viruses within a host cell; host cell responses to viral infections; and viral evolution. It includes a survey of adaptive strategies viruses use to meet specific situations, with illustrations taken from bacterial, animal, and plant viruses.

**PREREQUISITES:** BIOL-2902(3) and BIOL-2301(3).

**COREQUISITE:** BIOL-3221(3).

**BIOL-4931(3) IMMUNOLOGY (Le3)** Immunology is the study of the defence system which the body has evolved to protect itself from external threats such as viruses and internal threats such as tumour cells. Topics to be covered include non-specific immunity, acquired immunity, the structure, function and genetics of antibodies, antigen-antibody interactions, cells and organs of the immune system, autoimmunity, MHC and T-cell receptors, cytokine signalling and applications of immunology.

**PREREQUISITES:** BIOL-2301(3), BIOL-3221(3), and BIOL-3901(3).