

ELECTIVE COURSES

Available for M.S. or Ph.D. Degree

All credits for either the EOP or CMP emphasis will be at the 5XXX or 8XXX level. Electives available for students in either the EOP or the CMP emphasis are listed below. Except for proposed courses (as indicated), all courses are currently offered. There are numerous electives on the Twin Cities campus that parallel this list of electives on the Duluth campus. We will consult with Twin Cities faculty regarding the eligibility of specific elective courses on the Twin Cities campus as needed. A list of potential Twin Cities electives is provided on pages 40-42.

<u>Number</u>	<u>Title</u>	<u>Credits</u>	<u>Average Enrollment</u>	<u>Frequency</u>
Systems Biology				
Biol 5401	Coevolution	3	12	Annual
Biol 5805	Fisheries Ecology	3	6	Annual
Biol 5807	Mathematical Ecology	3	8	Biannual
Biol 5833	Stream Ecology	4	17	Biannual
Biol 5839	Coral Reef Field Studies	3	15	Biannual
Biol 5861	Lake Ecology	3	32	Annual
Biol 5862	Advanced Lake Ecology	3	6	Biannual
Biol 5863	Ecosystems Ecology	3	22	Biannual
Biol 5864	Ecosystems Ecology Laboratory	1	8	Biannual
Biol 5865	Conservation Biology	2	27	Biannual
Biol 5867	Managing Lakes and Streams	3	15	Biannual
Biol 8899	Seminar in Ecology	1	6	Annual
Lim 5001, 5002	Limnology Sequence	3	14	Annual
Microbial Biology				
Biol 5801	Microbial Ecology	2	11	Biannual
Biol 5802	Microbial Ecology Laboratory	2	3	Biannual
Animal Biology				
Biol 5361	Developmental Biology	4	23	Annual
Biol 5513	Experimental Immunology	4	12	Biannual
Biol 5760	Fish Physiology	3	7	Biannual
Biol 5772	Neural Mechanisms of Behavior	3	16	Biannual
Biol 5990	Current Topics in Neurobiology	1	5	Biannual
MicB 5545	Immunobiology	3	15	Annual
MicB 8554	Advanced Immunobiology	3	6	Annual
Phsl 5601	Physiology of Organ Systems I	4	26	Annual
Phsl 5602	Physiology of Organ Systems II	2	14	Annual
Txcl 5011	Principles of Toxicology	2	3	Annual
Plant Biology				
Biol 5121	Plant Biochemistry & Molecular Biology	4	10	Biannual
Biol 5602	Plant Physiology Laboratory	2	8	Annual

Biol 5811	Plant Autecology	3	4	Annual
Biol 5831	Plant Population & Community Ecology	4	5	Annual

<u>Number</u>	<u>Title</u>	<u>Credits</u>	<u>Average Enrollment</u>	<u>Frequency</u>
Biochemistry, Cell and Molecular Biology				
Biol 4231	Molecular Genetics	3	26	Annual
Biol 5233	Genomics	3	24	Annual
Biol/Chem 5232	Molecular Biology Laboratory	2	20	Annual
Chem 8224	Advanced Analytical Chemistry	5	2	Biannual
MdBc 5501	Neurobiochemistry	2	4	Annual
Phcl 8101	Signal Transduction (proposed)	2		
Phsl 8441	Transport Processes	2	3	Annual
Physiology				
Phsl 5211	Literature Seminar	1-2	Unknown	Annual
Phsl 5292	Readings in Physiology	1-3	Unknown	Annual
Phsl 5294	Research in Physiology	1-15	Unknown	Annual
Phsl 5601	Physiology of Organ Systems I	4	Unknown	Annual
Phsl 5602	Physiology of Organ Systems II	2	Unknown	Annual
Phsl 5701	Sensory Physiology	2	Unknown	Biannual
Pharmacology				
Phcl 5201	Pharmacology I	6	Unknown	Annual
Phcl 5202	Pharmacology II	5	Unknown	Annual
Phcl 5204	Pharmacology Seminar	1	Unknown	Annual
Phcl 5410	Advanced Pharmacology	1	Unknown	Annual
Phcl 5702	Cell Signaling	2	Unknown	Biannual
Mathematics and Statistics				
Math 5260	Dynamical Systems	3	14	Biannual
Math 5270	Modeling with Dynamical Systems	3	10	Biannual
Stat 5511	Regression Analysis	3	27	Annual
Stat 5515	Multivariate Statistics	3	10	Annual
Anatomy and Cell Biology				
Anat 5133	Developmental, Cell and Tissue Biology	5	Unknown	Annual
Anat 5246	Seminar in Cell Biology	1	Unknown	Annual
Anat 5521	Gross Anatomy	7	Unknown	Annual
Anat 5523	Microscopic Anatomy	5	Unknown	Annual
Anat 5533	Neuroanatomy	4	Unknown	Annual
Behavioral Sciences				
BhSc 5432	Clinical Psychopharmacology	3	Unknown	Annual

BhSc 5491	Problems in Medical Behavioral Sciences	1-6	Unknown	Annual
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<u>Number</u>	<u>Title</u>	<u>Credits</u>	<u>Average Enrollment</u>	<u>Frequency</u>
Biochemistry and Molecular Biology				
MdBc 5201	Topics in Biochemistry	3	Unknown	Annual
MdBc 5202	Cellular and Molecular Biology	3	Unknown	Annual
MdBc 5501	Neurobiochemistry	2	Unknown	Annual
Family Medicine				
FMed 5591	Independent Study	1-8	Unknown	Annual
Medical Microbiology and Immunology				
MicB 5545	Immunobiology	3	Unknown	Annual
MicB 5555	Molecular Pathogenesis: Current Concepts	3	Unknown	Annual
MicB 5591	Problems in Medical Microbiology and Immunology	1-4	Unknown	Annual

These electives will be expanded by generating one new 8000 level course each year for the first ten years of the doctoral program. We also will attempt to capture desirable 8000 level courses from Twin Cities-based programs. Examples of Twin Cities-based electives include the following:

- Biochemistry 8216 (Signal Transduction and Gene Expression)
- Child Psychology 8301 (Developmental Psychology: Cognitive Processes)
- Child Psychology 8302 (Developmental Psychology: Social and Emotional Processes)
- Child Psychology 8311 (Landmark Issues in Child Psychology)
- Clinical Pharmacology 8220 (Experimental and Clinical Pharmacology)
- Clinical Pharmacology 8400 (Pharmacometrics)
- Clinical Pharmacology 8410 (Population Pharmacokinetic Modeling)
- Cognitive Science 8040 (Cognitive Neuroscience)
- Comparative and Molecular Biosciences 8201 (Mechanisms of Animal Health and Disease I)
- Comparative and Molecular Biosciences 8202 (Mechanisms of Animal Health and Disease II)
- Comparative and Molecular Biosciences 8335 (Molecular Biological Techniques)
- Comparative and Molecular Biosciences 8344 (Mechanism of Hormone Action)
- Comparative and Molecular Biosciences 8371 (Mucosal Immunobiology)
- Comparative and Molecular Biosciences 8481 (Advanced Neuropharmaceutics)
- Comparative and Molecular Biosciences 8550 (Comparative and Molecular Biosciences)
- Conservation Biology 8004 (Economic and Social Aspects of Conservation)
- Ecology Evolution and Behavior 8051 (Empirical Ecology)
- Ecology Evolution and Behavior 8601 (Introduction to Stream Restoration)

Ecology Evolution and Behavior 8602 (Stream Restoration)
Ecology Evolution and Behavior 8641 (Spatial Ecology)
Entomology 8041 (Advanced Insect Genetics)
Entomology 8051 (Toxicology)
Experimental and Clinical Pharmacology 8210 (Clinical Therapeutics)
Fisheries and Wildlife 8448 (Fishery Science)
Fisheries and Wildlife 8452 (Conservation Biology)
Fisheries and Wildlife 8459 (Stream and River Ecology)
Fisheries and Wildlife 8576 (Biology and Management of Large Animals)
Forest Resources 8207 (Economic Analysis of Natural Resource Projects).
Genetics Cell Biology and Development 8008 (Mammalian Gene Transfer and Expression)
Genetics Cell Biology and Development 8073 (Advanced Human Genetics)
Genetics Cell Biology and Development 8103 (Human Histology)
Genetics Cell Biology and Development 8131 (Advanced Genetics)
Genetics Cell Biology and Development 8151 (Cell Structure and Function)
Genetics Cell Biology and Development 8161 (Advanced Developmental Biology)
Genetics Cell Biology and Development 8913 (Psychosocial Issues in Genetic Counseling)
Genetics Cell Biology and Development 8914 (Ethical and Legal Issues in Genetic Counseling)
Microbiology 8002 (Structure, Function and Genetics of Bacteria)
Microbiology 8003 (Immunity and Immunopathology)
Microbiology 8004 (Cellular and Cancer Biology)
Microbiology 8007 (Cell Biology and Biochemistry of the Extracellular Matrix)
Microbiology 8009 (Biochemical Aspects of Normal and Abnormal Cell Growth and Cell Death)
Microbiology 8010 (Microbial Pathogenesis)
Microbiology 8012 (Integrated Topics in Microbiology, Immunology and Cancer Biology)
Microbiology 8371 (Mucosal Immunobiology)
Neuroscience 8026 (Neuro-Immune Interactions)
Neuroscience 8211 (Developmental Neuroscience)
Neuroscience 8216 (Selected Topics in Autonomic and Neuroendocrine Regulation)
Neuroscience 8217 (Systems and Computational Neuroscience)
Neuroscience 8221 (Neurobiology of Pain and Analgesia)
Neuroscience 8222 (Central Regulation of Autonomic Function)
Neuroscience 8247 (Anatomy and Physiology of Hearing and Balance)
Neuroscience 8481 (Advanced Neuropharmaceutics)
Nutrition 8613 (Advances in Nutrition: Lipoproteins, Cholesterol and Atherosclerosis)
Nutrition 8614 (Advances in Nutrition: Advanced Energy Balance)
Nutrition 8615 (advances in Nutrition: Exercise Metabolism)
Nutrition 8616 (Advances in Nutrition: Free Radicals, Trace Elements and other Micronutrients)
Nutrition 8617 (Chemical Carcinogenesis and Chemoprevention)
Nutrition 8618 (Neuroregulation of Energy Metabolism)

Pharmacology 8208 (Neuropsychopharmacology)
Pharmacology 8217 (Problems in Investigative Pharmacology)
Pharmacology 8221 (Neurobiology of Pain and Analgesia)
Pharmacology 8222 (Transdisciplinary Tobacco Research)
Pharmacy 8411 (Stabilization of Pharmaceuticals)
Pharmacy 8421 (Advanced Pharmacokinetics)
Pharmacy 8431 (Controlled Release: Materials, Mechanisms and Models)
Pharmacy 8441 (Solubility and Solid-state Properties of Drugs)
Physiology 8216 (Selected Topics in Autonomic and Neuroendocrine Regulation)
Physiology 8222 (Central Regulation of Autonomic Function)
Physiology 8310 (Advanced Topics in Cellular Physiology)
Plant Pathology 8101 (Causal Organisms of Plant Disease)
Plant Pathology 8102 (Epidemiology and Genetics of Host-Parasite Interactions)
Plant Pathology 8103 (Plant Microbe Interactions)
Plant Pathology 8302 (Genomics of Plant Associated Microbes)
Soil Water and Climate 8252 (Advanced Soil Physics)
Soil Water and Climate 8282 (Modeling Water, Carbon and Nitrogen Dynamics in the
Soil-Plant-Air System)
Soil Water and Climate 8541 (Aquatic and Soil Chemistry)
Statistics 5021 (Statistical Analysis)
Statistics 8111 (Mathematical Statistics I)
Statistics 8112 (Mathematical Statistics II)
Statistics 8141 (Probability Assessment)
Statistics 8311 (Linear Models)
Statistics 8312 (Linear and Nonlinear Regression)
Toxicology 8012 (Advanced Toxicology I)
Toxicology 8013 (Advanced Toxicology II)
Toxicology 8100 (Investigative Toxicology)

Credits for the Ph.D. vs. M.S. Degree

Many programs require more coursework for the Ph.D. degree than for the M.S. degree. Examination of program requirements on the Graduate School website also indicates a wide variety in course requirements for M.S. and Ph.D. programs throughout the University of Minnesota. For example, per the 2006-2007 Biochemistry, Molecular Biology, Biophysics (BMBB) Handbook (http://cbs.umn.edu/gpbmbb/docs/BMBB_Grad_Handbook-06-07.pdf), the BMBB graduate program requires 9 credits of required core courses for the M.S. and Ph.D., but the Ph.D. requires 12 credits in a related field, and the Plan A M.S. requires only 6 credits in a related field. The Ecology, Evolution and Behavior graduate program (<http://www.cbs.umn.edu/eeb/graduateprogram/handbook/>) requires 14 credits in the major, and 6 in a related field for the M.S., whereas at least 3 credits in the major are required for a Ph.D. degree, and an additional 12 in a related field.

We have seriously considered the Biological Sciences P&R Council's concern regarding the lack of difference between the credit requirements currently in place for the M.S. program in IBS vs. the proposed IBS Ph.D. credit requirements. Thus, we have proposed

the addition of a required 2 credit Special Topics in IBS course (IBS 8980) for the second year Ph.D. students in IBS. This course would function to add to the core content of the Ph.D. program, as well as to reinforce the integration of the EOP and CMP emphases for the Ph.D. students at the end of their second year of coursework. We totally agree that this type of experience is essential to excellent doctoral education and would help to promote a community of learners. With the addition of this course, the IBS Ph.D. students will take a minimum of 32 credits of coursework and 24 thesis credits. This compares favorably with requirements of other Ph.D. biological sciences programs cited above. In contrast, IBS Masters students are currently required to take a minimum of 22 credits of coursework and 10 thesis credits.

7. Anticipated Timing for Completing a Degree in the IBS Program

Ph.D. in Integrated Biosciences

Year	Fall Semester	Spring Semester	Summer
1	Rotations (CMP) and Advisor selection Coursework	Advisor selection Coursework	File degree program Research
2	Coursework Research	Coursework Research	Completion of written preliminary exam Research
3	Completion of oral prelim exam Research	File thesis proposal form Research	Research
4	Research, thesis writing	Research, thesis writing	Research, thesis writing
5	Final oral defense		

7.A. Selecting an Advisor

Rotations through three faculty laboratories during the first semester for CMP Ph.D. students, the orientation course at the start of the first year of graduate study, and attendance at faculty Colloquia will all help the student choose an appropriate advisor. CMP Ph.D. students will be required to complete three rotations, each four to five weeks in length, during the Fall semester. While students are serving their rotations, the DGS will advise them in consultation with the appropriate Emphasis Coordinator. During the rotations, the student may have a tentative assignment to an advisor for a trial period of a semester. During the rotation period, students will request assignment to an advisor in consultation with the DGS. EOP students will be encouraged to also do rotations or take three credits of electives instead. These rotations will assist the student in the selection of an advisor within the emphasis, as well as provide exposure to research in the other emphasis. However, because of the tradition in ecology graduate programs, EOP students will likely enter the IBS program with an advisor in mind.

The advisor may be chosen from IBS faculty on either campus. The DGS will then consult with program faculty before the advisor assignment is finalized. The DGS has final approval on all advisor assignments after he or she has consulted with the student and the program faculty. All advisor assignments will be finalized by the end of Fall semester of the first year.

7.B. Filing Degree Program with the Graduate School

Students will be required to file degree programs as early as possible, but no later than the end of the third semester of study. As per Graduate School regulations, the Examining Committee for the Ph.D. degree will consist of at least four individuals, including the advisor. One of the individuals on the Examining Committee will represent graduate faculty from the related field. For the Ph.D. degree, two of the Examining Committee members must come from a different department than the tenure home of the advisor. A student's committee must have at least one faculty member from the emphasis other than the student's major emphasis.

(http://www.grad.umn.edu/dgs/handbook/student_services/PhD.html)