

BIOLOGY with an option in Neurobiology

http://www.biology.wisc.edu/Academic_Programs/Biology/Neurobiology

Institute for Cross-college Biology Education

Colleges of Letters & Science and Agricultural & Life Sciences

(updated June 2009)

What is the Biology Major?



The Biology Major is designed for students who are interested in a broad exposure to the concepts and methodologies of the biological sciences, as well as those interested in a more specific sub-discipline. The focus of the student's program is determined by the student with a biology advisor of the student's choosing. This major is appropriate for students interested in post-graduate careers in any biological science or health profession. It is also appropriate for students who think that a good knowledge of biology and the scientific process will help them in a non-biological career.

What is the Neurobiology Option?

The neurobiology option allows Biology majors to concentrate their studies in neurobiology and to have this reflected on their transcript. Since there is no Neurobiology major available at UW-Madison, this is the only mechanism to indicate specialization in this rapidly growing and popular field. In taking this option students will be able to fulfill their intermediate/advanced biology requirement with courses that emphasize neuroscience, ranging from 2 required courses in fundamental neuroscience to more advanced optional courses that cover a wide range of neuroscience topics. They will also get to take a 1 credit seminar course in which different neuroscience faculty from the campus present their work in an informal setting.

Who should enroll in this Major?

Students with broad interest in the biological sciences who want to:

- Prepare for graduate study in Neurobiology or related fields
- Prepare for professional studies (e.g. medical school, veterinary school, dentistry)
- Concentrate their biological studies in neurobiology

Students majoring in Biology must complete 31 credits of biological coursework plus the college requirements for a degree in either the College of Agricultural & Life Sciences (CALS) or the College of Letters & Science (L&S).

Students are advised by professors from many biological departments based on interests. Those expressing no college preference are assigned to L&S but advised also to keep track of CALS requirements to keep options open.

Degree Requirements

The degree requirements for the Biology Major consist of three parts:

1. **University-wide** requirements for communications, quantitative reasoning, and ethnic studies
2. **College-level** requirements (CALS or L&S)
3. **Biology Major** requirements for chemistry, math, physics, and biology are the same regardless of college and will satisfy the degree requirements of both colleges.

The official requirements are listed in the "Document of Record" which is the Undergraduate Catalog. For your convenience, some of the important college level requirements are listed here but **this is an unofficial list**. Please refer to the web site or printed copy of the UW-Madison Undergraduate Catalog for the official list. **CALS** requirements are located at: <http://www.wisc.edu/pubs/ug/04cals/degrees.html>; **L&S** requirements at: <http://www.wisc.edu/pubs/ug/10lettsci/degrees.html>

CALS		L&S	
International Studies	3 credits	Foreign Language	3 sem. or 3 yrs. in HS
Econ or AAE	3- 4 credits	Literature	6 credits
Social Sciences	3 credits	Social Sciences	12 credits
Humanities	6 credits	Humanities	6 credits

Curriculum

In addition to fulfilling all University and College requirements, students must fulfill the following major requirements.

1. Mathematics

Math 171: Calc with Algebra & Trig I (5cr) and Math 217: Calc with Algebra & Trig II (5 cr)
OR Math 221: Calc & Analytic Geometry (5 cr)

AND

Math 222: Calc & Analytic Geometry (5 cr) OR Stat 301: Intro to Statistical Methods (3 cr) OR Stat 371: Intro to Applied Stats for the Life Sciences (3 cr)

(Some biological sciences majors require Math 222.)

2. Chemistry

a. General Chemistry:

Chem 103 and 104: General Chem (4 cr, 5 cr) OR 109*: General and Analytical Chem (5 cr)

*(*Some medical schools require two semesters of inorganic chemistry.)*

b. Organic Chemistry:

Chem 343: Intro to Organic Chem (3 cr) and Chem 344: Intro Organic Chem Lab (2 cr) and Chem 345: Intermediate Organic Chem (3 cr)

3. Physics

Physics 103 and 104: General Physics (4 cr each), OR Physics 201 and 202: General Physics (5 cr each) OR Physics 207 and 208: General Physics (5 cr each)

(Some biological science majors require calculus-based physics courses.)

Biology Courses

(The total number of credits in sections 4, 5, and 6 must equal at least 31.)

4. Introductory Biology Courses

Option A:

Biology/Botany/Zoology 151 and 152: Intro Biology (5 cr each) plus one foundational course.

Option B:

Biocore/Biology 301: Evolution, Ecology, & Genetics (3 cr), 303: Cellular Bio (3 cr), 323: Organismal Bio (3 cr), 333: Biological Interactions (3 cr)

AND two of the following lab courses:

Biocore/Biology 302: Evolution, Ecology, & Genetics lab (2 cr), 304: Cellular Bio lab (2 cr), 324: Organismal Bio lab (2 cr)

(Students who use Biocore/Biology 302 and 304 to fulfill the introductory biology requirement can use Biocore/Biology 324 to fulfill the intermediate lab or field course requirement described in part 5 below.)

Biocore is highly selective and based upon applications due in mid-March. You may pick up an application from the Biocore office (345 Noland Hall), or call 262-5979 for more information.

Option C:

Biology/Zoology 101: Animal Biology (3 cr), Biology/Zoology 102: Animal Biology lab (2 cr),
Biology/Botany 130: General Botany (5 cr) plus one foundational course.

Foundational Courses: (The course used to satisfy this requirement does not count toward requirement 5):

Genetics

Botany/Genetics/Zoology 466: General Genetics
Microbio 370: Bacterial Genetics
Agronomy 338: Plant Breeding and Biotechnology

Biochemistry

Biochem 501: Intro to Biochemistry
Bmolchem 503: Human Biochemistry

(Students are best prepared for graduate study or professional school by taking both a genetics course and a biochemistry course.)

5. Intermediate/advanced courses (13 credits minimum)

Required: Neurosci/ Psych/ Zoology 523: Neurobiology I AND Neurosci/ Psych/ Zoology 524: Neurobiology II
(NOTE: It is very useful to take Physics 208 or its equivalent prior to, or concurrent with, Neurobiology I)

At least 13 intermediate/advanced level credits are needed to satisfy the biology breadth requirement. In addition to the above two required courses, students must take a minimum of three more courses: one from category “a”, one from category “b” and one from categories “c” or “d”. The course or courses used to satisfy any category must be at least, or add up to, 2 credits. At least three hours per week of laboratory/field instruction from a course or courses in a) through f) must be taken. Additional courses from a-f can be taken to fulfill the 31 credit requirement.

- a. Cellular and Molecular Neurobiology
- b. Systems Neurobiology
- c. Ecology
- d. Evolution and Systematics
- e. Applied Biology, Agriculture and Natural Resources
- f. Other lab courses

Appendix I provides a list of courses for meeting these breadth requirements. *Please see the explanatory note at the beginning of that appendix.*

6. Laboratory or field research experience (2 credits, minimum)

This requirement is expected to be fulfilled with a research-based senior thesis/independent study in neurobiology by registering for 2 or more Independent Study 699 credits in the supervising professor's department. Alternatively it may be fulfilled with one or more intermediate/advanced laboratory courses involving a total of **at least 3 hours/week** of lab instruction **beyond that done for requirement 5**. We expect that most students who choose to concentrate in neurobiology will be interested in an independent research experience in one of the many labs on campus. Indeed, we strongly urge all concentrators to do a senior thesis or independent research. However, we recognize not all students will want to do research. Hence the requirement can also be fulfilled by one of the courses listed below. With advisor approval, this requirement meets the CALS capstone (see: www.biology.wisc.edu/Academic_Programs/Biology/Student_Resources/Capstone.asp) experience.

Dept.	No.	Cr.	Lab hrs. /wk.	Course Title
BMOLCHEM	504	2	4	Human Biochemistry Laboratory
NEUROSCI/PHYSIOL	625	2	4	Brain Cell Cultures Lab Course
ZOOLOGY	430	5	6	Comparative Anatomy of Vertebrates
ZOOLOGY	555	3	6	Developmental Biology Laboratory
ZOOLOGY	572	3	6	Cell Biology Laboratory
ZOOLOGY	612	2	4	Comparative Physiology Laboratory

7. NEUROSCI 500: Undergraduate Neurobiology Seminar (1 credit)

This seminar will provide a weekly research seminar given by UW-Madison faculty active in Neurobiology or by students in the major and directed specifically to undergraduates. It will give those Biology majors who choose the neurobiology track an orientation to the wide range of research questions in modern neurobiology at UW-Madison as well as provide a weekly social gathering. This seminar is best taken in the second semester of your junior year or first semester of your senior year.

APPENDIX I –Curriculum for the Biology Major with Neurobiology option

Intermediate/ Advanced Courses for the Biology Breadth Requirement #5

In accumulating other biology credits toward the total credits required for their degrees (120 in L&S and 124 in CALS), students, in consultation with their advisors, will have the opportunity to take many biology electives of interest to them. All courses listed below have prerequisites that would be satisfied by the general requirements of the Biology major. Courses with higher prerequisites that satisfy requirement 5 can be found on the website. Other courses may also be appropriate and can be approved on a case-by-case basis. Many courses are given in alternate years. Also, new courses are regularly added to the curriculum so you should always consult the web site (Student Resources) to see what is actually available in any particular semester.

NOTE: Courses listed in 5A and B indicate when they are given (i.e., Even = 2006, 2008, etc. Odd = 2007, 2009, etc.). SS= summer session. Please refer to the Undergraduate Catalog for more complete course descriptions.

a. Cellular and Molecular Neurobiology

Dept.	No.	Cr	Lab hrs/wk	Offered	Course Title
NEUROSCI/ PHYSIOL	610	4		Fall	Cellular and Molecular Neuroscience
NEUROSCI/ PHYSIOL	625	2	4	Irregular	Brain Cell Cultures Lab Course
NEUROSCI	629	3		Fall Even	Molecular Mechanisms of Memory
NEUROSCI/ ZOOLOGY	635	2		Spring Even	Neurobiology of Disease
NEUROSCI	670	2-3		Spring	Stem Cells and the Central Nervous System
NEUROSCI	675	2		Fall Odd	Molecular Mechanisms of Brain Damage
NEUROSCI	675	2		Spring Odd	Reproductive Neuroendocrinology
PSYCH	411	3		Spring Even	Neurochemistry of Drugs and Behavior
ZOOLOGY	555	3	6	Fall	Laboratory in Developmental Biology
ZOOLOGY	625	2		Spring Odd	Development of the Nervous System
ZOOLOGY	765	3		Spring	Developmental Neurobiology (Advanced)

b. Systems Neurobiology

Dept.	No.	Cr	Lab hrs/wk	Offered	Course Title
COM DIS	503	3		Fall	Neural Mechanisms of Speech, Hearing and Language
KINES	721	3		Fall Odd	Neural Basis of Movement
NEUROSCI/ PHYSIOL	611	4		Spring	Systems Neuroscience
NEUROSCI	630	3		Spring Even	Neuronal Mechanisms for Sensation & Memory in the Cerebral Cortex
NEUROSCI	675	3		Fall & Spring	Basic Sleep Mechanisms and Sleep Disorders
NEUROSCI/ ZOOLOGY	675/ 932	2		Fall Odd	Brain, Behavior and Evolution
NEUROSCI/ ZOOLOGY	675	2		Fall Even	Neuroethology
NEUROSCI	675	2		Fall	Functional Brain Imaging of Cognitive Disorders
PSYCH	406 (486)	3 (1)		Fall Even	Psychology of Perception (Honors credit)
PSYCH	411	3		Spring	Sex differences in the brain
PSYCH	414	3		Spring	Cognitive Psychology
THER SCI	713	3		Fall Even	Neural Basis of Normal and Pathological Movement

c. Ecology

Dept.	No.	Cr	Lab hrs/wk	Course Title
AGRON/ ENV TOX/ ENTOM/ F&W ECOL	632	1		Ecotoxicology: The Chemical Players
AGRON/ ENV TOX/ ENTOM/ F&W ECOL	633	1		Ecotoxicology: Impacts on Individuals
AGRON/ ENV TOX/ ENTOM/ F&W ECOL	634	1		Ecotoxicology: Impacts on Populations, Communities and Ecosystems

BOTANY	450	2		Midwestern Ecological Issues: A Case Study Approach
BOTANY/ F&W ECOL	455	4	5	Vegetation of Wisconsin
BOTANY/ F&W ECOL/ ZOOLOGY	460	4	3	General Ecology
BOTANY	468	3		Patterns in Biological Design: An Introduction to Systems Biology
ENTOM	342	3		Insect Ecology
ENVIR ST/ ZOOLOGY	315	2		Limnology: Conservation of Aquatic Resources
ENVIR ST/ LAND ARC	361	3		Wetlands Ecology
F&W ECOL	318*	2		Principles of Wildlife Ecology
F&W ECOL	379	3		Principles of Wildlife Management
F&W ECOL	550	3-4	2	Forest Ecology
PL PATH	300	3	3	Introduction to Plant Pathology
ZOOLOGY	316	2	4 or 8 SS	Limnology: Conservation of Aquatic Resources Laboratory
ZOOLOGY	504	3-5	2	Modeling Animal Landscapes

*F&W ECOL 318 will move from C to E for students declaring the Biology Major Fall 2008 or later.

d. Evolution and Systematics

Dept.	No.	Cr	Lab hrs/wk	Course Title
ANTRHO	304	3		Heredity, Environment and Human Populations
ANTHRO/ BOTANY/ ZOO	410	3		Evolutionary Biology
ANTHRO	458	3		Primate Behavioral Ecology
ANTHRO	641	3-4		The Nutritional Ecology of Human Evolution
ANTHRO	658	3		Ecological Models of Behavior
BOTANY	400	4	3	Plant Systematics
BOTANY	401	4	4	Vascular Flora of Wisconsin
BOTANY	422	3		Plant Geography
BOTANY	430	3		Tropical Plant Diversity
ENVIR ST/ F&W ECOL/ ZOOLOGY	360	3		Extinction of Species
GEOLOGY	544	2		Evolution of the Vertebrates
PSYCH	449	3		Animal Behavior
PSYCH	450	3		Animal Behavior – The Primates
ZOOLOGY	425	3		Evolution of Behavior

e. Applied Biology, Agriculture and Natural Resources

Dept.	No.	Cr	Lab hrs/wk	Course Title
AAE/ AGRONOMY/ INTER-AG/NUTRSCI	350	3		World Hunger and Malnutrition
AGRONOMY	300	3		Cropping Systems
AGRONOMY	302	3		Forage Management and Utilization
AGRON/ HORT	328	4	2	Integrated Weed Management
AGRONOMY	377	3		Cropping Systems of the Tropics
AGRON/ HORT	501	3		Principles of Plant Breeding
AN SCI/ DY SCI/ NUTR SCI	311	3		Comparative Animal Nutrition
AN SCI/ DY SCI	313	1	2	Animal Feeds and Diet Formulation
AN SCI	503	3	15 SS	Avian Physiology
AN SCI	509	3	2	Poultry Breeding
AN SCI	512	3	15 SS	Management for Avian Health
ENTOM	351	3		Principles of Economic Entomology
ENTOM/ F&W ECOL/ PL PATH	500	4	3	Insects and Diseases in Forest Resource Management
ENTOM/ ZOOLOGY	371	3	3	Medical Entomology
ENVIR ST/POPHLTH	471	3		Introduction to Environmental Health
ENVIR ST/POPHLTH	502	3		Air Pollution and Human Health
ENVIR TOX/	625	3		Toxicology I

MEDICINE/ ONCOL/ PATH, PHMCOL- M/POP HLTH/ PHM SCI				
FOOD SCI	375	2		Food Bio Sciences
FOOD SCI	530	2		Food Processing I
FOOD SCI	532	3	4	Food Processing II
F&W ECOL/ HORT/ LAND ARC/ PL PATH	309	2	3	Diseases of Landscape Trees and Shrubs
F&W ECOL	306	3	2	Terrestrial Vertebrates: Life History and Ecology
F&W ECOL/ ZOOLOGY	335	3		Human/Animal Relationships: Biological and Philosophical Issues
F&W ECOL	410	3-4	3	Principles of Silviculture
F&W ECOL	415	3		Tree Physiology
F&W ECOL	548	3		Diseases of Wildlife
F&W ECOL	561	3	4	Wildlife Management Techniques
HORT	370	3	2	World Vegetables Crops
HORT	382	1-3		Organic Colloquium
HORT	392	2		
HORT	500	3	3	Molecular Biology Techniques
MED PHYS/ PHYSICS	463	2-3	3	Radioisotopes in Medicine and Biology
MM&I	554	2		Emerging Infectious Diseases and Bioterrorism
NUTR SCI	320	3		Nutrition for Health and Disease
NUTR SCI	332	3		Human Nutritional Needs
PL PATH/ SOIL SCI	323	2		Soil Biology
SOIL SCI	321	2		Soils and Environmental Chemistry
ZOOLOGY	675	2-3		Modern Biological Microscopy

f. Other lab courses

Dept.	No.	Cr	Lab hrs/wk	Course Title
AGRONOMY/ BOTANY/HORT	339	4	3	Plant Biotechnology Principles and Techniques I
AGRONOMY/ BOTANY/HORT	340	4	3	Plant Biotechnology Principles and Techniques II
AN SCI	404	4	3	Vertebrate Physiology
AN SCI/ DY SCI	434	3	2	Reproductive Physiology
AN SCI/DY SCI	362	2	2	Veterinary Genetics
BIOCORE/BIOLOGY #	324	2	3	Organismal Biology Laboratory
BMOLCHEM	504	2	6	Human Biochemistry Laboratory
BOTANY	300	4	4	Plant Anatomy
BOTANY	305	4	4	Principles of Plant Structure
BOTANY	330	3	4	Algae
BOTANY	332	4	4	Fungi Laboratory
BOTANY	402	2	4	Dendrology
BOTANY	500	3-4	3	Plant Physiology
BOTANY/ GENETICS/ HORT	561	3	2	Introductory Cytogenetics
ENTOM/ ZOOL	302	4	3	Introduction to Entomology
GENETICS	545	2	4	Genetics Laboratory
MICROBIO	304	2	4	Prokaryotic Microbiology Laboratory
MM&I/ ZOOLOGY	351	2	4	Parasitology Laboratory
MM&I	529	2	3	Immunology Laboratory
PHYSIOL	335	5	2	Physiology
PL PATH	332	4	4	Fungi
PSYCH	455	1	2	Behavioral Neuroscience Laboratory
PSYCH	485	1	2	Honors Laboratory in Behavioral Neuroscience
ZOOLOGY	430	5	6	Comparative Anatomy of Vertebrates

ZOOLOGY	521	2	2	Field Ornithology
ZOOLOGY	555	3	6	Laboratory in Developmental Biology
ZOOLOGY	572	3	6	Cell Biology Laboratory
ZOOLOGY	612	2	4	Comparative Physiology Laboratory

Students must have taken Biocore 302 and 304 to count 324 towards fulfilling requirement 5.

Honors in the Major Requirements for CALS

Honors in the Major in Biology is an undergraduate program designed for students who desire a more challenging academic program leading to a degree with the designation "With Honors". The program has a prescribed 20 credit requirement of Honors or equivalent courses in addition to a Senior Honors Thesis involving at least 4 credits of a senior honors thesis course offered through an academic department. The student is obligated to submit their senior thesis to the Assoc. Dean of Academic Affairs and to present their work orally at the Spring CALS Research Forum.

To participate in the Honors in the Major Program, a student must be admitted to the CALS Honors Degree Program. This can be achieved by being in the upper 10% of their high school graduating class, by receiving an ACT score of 28 or an SAT score of 1240; students who have completed one or more semesters of college will need a 3.3 GPA in college courses.

The required 20 credits must be in courses that satisfy requirements 4 and 5 of the Biology Curriculum, although other courses can be approved by the Biology Curriculum Committee on a case-by-case basis. At least 6 credits of the 20 must be in courses at 500-level and above. Senior Honors thesis and other independent research credits do not count toward this 20-credit requirement.

Program staff will monitor progress toward the "Honors in the Major" degree in Biology. Questions should be directed to the Honors advisors. Students must maintain a GPA of 3.3 and satisfy the requirement listed above.

To apply: First declare the Biology Major, then pick up an Honors packet and Honors form from either the CALS Undergraduate Programs and Services in 116 Agricultural Hall or the Biology Major Office at 445 Henry Mall, room 118.

Before enrolling in an Honors thesis course, the student must produce a two-to-three page double-spaced thesis proposal that briefly introduces the biological problem and then describes the line of experimentation that is proposed for the thesis work. The student and his/her faculty mentor must sign the proposal before it is submitted to the Biology Major office. The Biology Major Honors Committee will evaluate the proposal and the student will be notified of its acceptability. The proposal should be submitted well before the semester begins to allow time for approval and possible resubmission. The department the thesis is done in will determine requirements (i.e. due date, format). Two copies of the completed thesis, signed by the faculty mentor, must be submitted to the Assoc. Dean of Academic Affairs, which must certify it before Honors can be awarded at graduation. An additional signed copy must be submitted to the Biology office.

For the requirements for Honors in Research or for Individualized Honors, see the CALS Undergraduate Programs and Services in 116 Agricultural Hall or "Guidelines and Specifications for Submitting Your Thesis" on the website for CALS Honors.

Honors Requirements for L&S

1. An overall GPA of 3.3 and GPA in the major of 3.3.
2. Completion of 13 credits of honors at the intermediate or advanced level for courses in the biological sciences. Choose one of the following three options:
 - a. 13 credits of requirement #5 for honors.
 - b. Foundational course for honors AND 10 credits of the #5 requirement for honors.
 - c. Biocore/Biology 323 and 333 AND 7 credits of the #5 requirement for honors.
3. Completion of six credits of Senior Honors Thesis in any of a number of biology departments across campus. The department the thesis is done in will determine requirements (i.e. due date, format).

To apply: First declare the Biology Major, then, pick up an Honors form from either the L&S Honors Office at 415 South Hall or the Biology Major Office at 445 Henry Mall, room 118. Before enrolling in an Honors thesis course, the student must produce a two-to-three page double-spaced thesis proposal that briefly introduces the biological problem and then describes the line of experimentation that is proposed for the thesis work. The student and his/her faculty mentor must sign the proposal before it is submitted to the Biology Major Office. The Biology Major Honors Committee will evaluate the proposal and the student will be notified of its acceptability. A copy of the completed thesis must be submitted to the Biology office.

Four Year Road Map for the Biology Major with Neurobiology option

This Road Map is a tool to assist you and your advisor in planning your academic career. Use it along with the Curriculum Sheet for your major, your DARS report, and the Timetable. Your specific program of study could, and probably will, look different. You need to customize the Road Map to fit your situation, and consult with your advisor about the best path for you.

Fall Semester	Credits	Spring Semester	Credits
Year 1			
Chem 103 or 109	4-5	Chem 104	5
Math*	2-5	Math	2-5
Communications or Breadth♣	6	Communications or Breadth	5-7
Total	12-16		12-17
Year 2			
Chem 343	3	Chem 344	2
Math (if needed)	5	Chem 345	3
Intro Biology**	3-5	Intro Biology**	3-5
Breadth	3	Breadth	4-6
Total	14-16		12-16
Year 3			
Physics	4-5	Undergrad Neuro Seminar	1
Intro Biology**	3-5	Physics	4-5
Neurobiology I	3	Intro Biology**	3-5
Others (Laboratory course)	?	Neurobiology II	3
Total	12-18	Others (Laboratory course)	?
			12-18
Year 4			
Intermediate/Adv. Biology (a, b; c or d)	3-5	Intermediate/Adv . Biology (a, b; c or d)	3-5
Capstone or research	2-3	Capstone or Research	2-3
Electives	7-10	Electives	7-10
Total	12-18		12-18

*Math course determined by placement scores. Biology Majors must complete Math 221 plus one additional math course.

♣Suggested that CALS freshmen investigate Inter-Ag 155: Issues in Agriculture, Environment, and Life Sciences.

**Students may complete Biology/Botany/Zoology 151-152 & a foundational course or Biology/Zoology 101-102, Biology/Botany 130 & a foundational course or Biocore (four lecture courses and two out of three lab courses are required).

L&S Chair	CALS Chair	Neurobiology Option
Dr. Seth Blair ssblair@wisc.edu 608-262-1345	Dr. Amy Charkowski amyc@plantpath.wisc.edu 608-262-7911	Dr. Peter Lipton plipton@wisc.edu 608-262-1709

Biology Major Student Services	My Faculty Advisor:
Mary Smith 445 Henry Mall, Room 118 biologymajor@icbe.wisc.edu 608-262-9690	Name: _____
	Dept:
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	Phone:
	Campus Address: