

# MOLECULAR AND CELLULAR NEUROSCIENCE (BS)

The B.S. in Molecular/Cellular Neuroscience focuses on the genetic, biochemical, and electrophysiological underpinnings of the development, function, plasticity, pathology, and repair of the nervous system.

Our neuroscience majors are designed to provide both breadth and depth to the neuroscience knowledge base of our students, and afford ample opportunities for developing creative and critical thinking skills needed to advance neuroscience (or any other life science field).

## Related Programs

### Major

- Cognitive and Behavioral Neuroscience (BS) (<https://catalog.luc.edu/undergraduate/arts-sciences/neuroscience/cognitive-behavioral-neuroscience-bs/>)

### Minor

- Neuroscience Minor (<https://catalog.luc.edu/undergraduate/arts-sciences/neuroscience/neuroscience-minor/>)

## Curriculum

Code	Title	Hours
<b>Basic Science and Math Foundations</b>		
BIOL 101 & BIOL 111	General Biology I and General Biology I Lab	4
BIOL 102 & BIOL 112	General Biology II and General Biology II Lab	4
BIOL 251	Cell Biology	3
BIOL 252 or BIOL 283	Cell Biology Laboratory Genetics Laboratory	1
BIOL 282	Genetics	3
BIOL 335 / STAT 335 or PSYC 304	Intro to Biostatistics Statistics	3
Select one of the following three sets of classes:		4
CHEM 101 & CHEM 111	General Chemistry A Lecture/Discussion and General Chemistry Lab A	
CHEM 105	Chemical Principles	
CHEM 160 & CHEM 161	Chemical Structure and Properties and Chemical Structure and Properties Laboratory	
Select one of the following three Lecture courses:		3-4
CHEM 180	Chemical Reactivity I	
CHEM 221	Organic Chemistry I Lec/Disc	
CHEM 223	Organic Chemistry A Lec/Disc	
Select one of the following Lab courses:		1
CHEM 112	General Chemistry Lab B	
CHEM 181	Chemical Reactivity I Lab	
MATH 131 or MATH 161	Applied Calculus I Calculus I	3-4
Select one of the following three sets of classes:		4
PHYS 111 & 111L	College Physics I Lec / Dis and College Physics Laboratory I	

PHYS 121 & PHYS 111L	College Physics I with Calculus Lecture/ Discussion and College Physics Laboratory I	
PHYS 125 & 125L	General Physics I Lec/Dis and General Physics Laboratory I	
Select one of the following three sets of classes:		4
PHYS 112 & 112L	College Physics II Lec/Disc and College Physics Lab II	
PHYS 122 & PHYS 112L	College Physics II with Calculus Lecture/ Discussion and College Physics Lab II	
PHYS 126 & 126L & 126F	General Physics II Lec/Dis and General Physics Laboratory II and Freshman Projects	
PSYC 101	General Psychology	3
<b>Neuroscience Foundations Courses</b>		
BIOL 362	Neurobiology	3
NEUR 101	Introduction to Neuroscience	3
PSYC 382 / BIOL 284	Behavioral and Cognitive Neuroscience	3
<b>Molecular/Cellular Neuroscience Track</b>		
<i>Molecular/Cellular Neuroscience Specialty Area Courses</i>		
One additional year of Chemistry lectures:		
Select one of the following:		3-4
CHEM 222	Organic Chemistry II Lec/Disc	
CHEM 224	Organic Chemistry B Lec/Disc	
CHEM 240	Chemical Reactivity II	
Select one of the following:		3-4
CHEM 102	General Chemistry B Lecture/Discussion	
CHEM 106	Basic Inorganic Chemistry	
CHEM 260	Quantitative Methods in Chemistry	
<i>Molecular/Cellular Neuroscience Lecture Electives</i>		
Select three of the following:		7-9
BIOL 307	Biology of Stem Cells	
BIOL 351	Sleep/Circadian Rhythms	
BIOL 352	Neurobiology of Feeding in Health and Disease	
BIOL 357	Neural Disease, Degeneration, and Regeneration	
BIOL 358	Developmental Neurobiology	
BIOL 381	Epigenetics	
BIOL 382	Molecular Genetics	
BIOL 395	Special Topics in Biology (select topics related to neuroscience)	
CHEM 361 / BIOL 366 or CHEM 370	Principles of Biochemistry Biochemistry I	
NEUR 300	Seminar in Neuroscience	
PSYC 240 / BIOL 240	Psychology-Biology of Perception	
PSYC 378	Drugs and Behavior	
PSYC 383 / COMP 386	Methods in Computational Neuroscience	
<i>Molecular/Cellular Neuroscience Lab Electives</i>		
Select two of the following:		3-8
BIOL 252	Cell Biology Laboratory	

or BIOL 283 Genetics Laboratory	
BIOL 315	Introductory Immunology Lec/Lab
BIOL 366L	Cell Physiology & Biochemistry Lab
or CHEM 372 Biochemistry Laboratory I	
BIOL 367	Bioimaging
BIOL 390	Molecular Biology Laboratory
BIOL 395L	Special Topics Laboratory (select topics related to neuroscience)
NEUR 301 / BIOL 373 / PSYC 388	Laboratory in Neuroscience I
PSYC 311 / BIOL 313	Lab in Psychobiology
or PSYC 316 Lab in Experimental Psychology: Sense & Perception	
PSYC 384 / COMP 389	Computational Modeling of the Brain
May include one of the following independent research options:	
BIOL 396	Research (with a Molecular/Cellular focus)
BIOL 398	Internship in Biology (with a Molecular/Cellular focus)
<i>Molecular/Cellular Neuroscience Capstone</i>	
BIOL 376	Seminar in Molecular/Cellular Neuroscience
or BIOL 358	Developmental Neurobiology
<b>Total Hours</b>	<b>68</b>

## Undergraduate Research

Neuroscience students have numerous opportunities to conduct scientific research in the labs of our neuroscience-affiliated faculty at Loyola's Lake Shore Campus (<https://www.luc.edu/neuroscience/aboutus/facultydirectoryandresearch/#den422313>), in the labs of other faculty on any of Loyola's campuses, or at other institutions in the Chicago area. Depending on the applicability of the research project to the student's Neuroscience Major or Minor, independent research may be able to qualify for course credit as one of the required specialty labs (see below).

## Molecular/Cellular Neuroscience Majors Research Credit

Molecular/Cellular Neuroscience (NRMC) majors can earn specialty lab credit for conducting **independent research that has a molecular/cellular focus** in labs within the biology department or at an appropriate external internship site. Please see the Specialty lab credit for independent research–NRMC document on the Neuroscience program website (<https://www.luc.edu/neuroscience/undergraduateresearch/>) for a more thorough explanation of earning NRMC credit through one of the 3-credit courses below:

- BIOL 396 Research (relevant research with faculty in Biology)
- BIOL 398 Internship in Biology (relevant research at an external site)

Please contact the NRMC Director for questions about earning credit from molecular/cellular or neuroscience-related research in other departments (e.g., chemistry, psychology).

## Suggested Sequence of Courses

Course	Title	Hours
<b>Freshman</b>		
<b>Fall</b>		
BIOL 101	General Biology I	3

BIOL 111	General Biology I Lab	1
CHEM 160	Chemical Structure and Properties	3
CHEM 161	Chemical Structure and Properties Laboratory	1
PSYC 101	General Psychology	3
MATH 131	Applied Calculus I	3
<b>Hours</b>		<b>14</b>

### Spring

BIOL 102	General Biology II	3
BIOL 112	General Biology II Lab	1
CHEM 180	Chemical Reactivity I	3
CHEM 181	Chemical Reactivity I Lab	1
NEUR 101	Introduction to Neuroscience	3
<b>Hours</b>		<b>11</b>

### Sophomore

#### Fall

PHYS 111	College Physics I Lec / Dis	3
PHYS 111L	College Physics Laboratory I	1
BIOL 251	Cell Biology	3
CHEM 240	Chemical Reactivity II	3
<b>Hours</b>		<b>10</b>

#### Spring

PHYS 112	College Physics II Lec/Disc	3
PHYS 112L	College Physics Lab II	1
BIOL 282	Genetics	3
CHEM 260	Quantitative Methods in Chemistry	3
BIOL 252	Cell Biology Laboratory	1
or BIOL 283	or Genetics Laboratory	
<b>Hours</b>		<b>11</b>

### Junior

#### Fall

BIOL 362	Neurobiology	3
STAT 335 / BIOL 335	Introduction to Biostatistics	3
or PSYC 304	or Statistics	
Specialty Lecture		1-3
<b>Hours</b>		<b>7</b>

#### Spring

PSYC 382	Behavioral and Cognitive Neuroscience	3
Specialty Lecture		1-3
<b>Hours</b>		<b>4</b>

### Senior

#### Fall

Specialty Lecture		3
Specialty Lab		3-4
<b>Hours</b>		<b>6</b>

#### Spring

BIOL 376	Seminar in Molecular/Cellular Neuroscience	3
or BIOL 358	or Developmental Neurobiology	
Specialty Lab		2-3
<b>Hours</b>		<b>5</b>
<b>Total Hours</b>		<b>68</b>

## Course Objectives

Because the nervous system is the organ for behavior, neuroscience cuts across traditional fields in the biological and behavioral sciences. Owing to this breadth, we have designed two major tracks for students who wish to focus on neuroscience in their course of study at LUC. Completing either of these options will prepare students well for a variety of careers, including but not limited to medicine and life sciences research, particularly in neuroscience-related fields. Both options require at least two semesters of courses in biology, chemistry, and physics.

### Lecture Course Objectives

Both of the majors require three courses in neuroscience fundamentals: NEUR 101 (<https://catalog.luc.edu/search/?P=NEUR%20101>) Introduction to Neuroscience, BIOL 362 (<https://catalog.luc.edu/search/?P=BIOL%20362>) Neurobiology (which stresses cellular and electrophysiological mechanisms of neural function), and PSYC 382 (<https://catalog.luc.edu/search/?P=PSYC%20382>)/BIOL 284 (<https://catalog.luc.edu/search/?P=BIOL%20284>) Behavioral and Cognitive Neuroscience (which stresses the neural substrates underlying mental processing and behavior). After completing this sequence, majors can design their own course of study within cognitive/behavioral or molecular/cellular neuroscience. There is some overlap in the list of lecture courses from which students may choose to complete their elective requirements, but there is also great diversity in the topics that are available in each major track.

### Lab Course Objectives

Aside from first-year labs in chemistry and biology, and organic chemistry lab for molecular/cellular neuroscience majors, neuroscience majors choose their own lab experiences. Because the nervous system is cellular, computational, and a control center, the range of techniques that are useful is extremely broad, from cellular/molecular to behavioral, and the student can decide which techniques will be most helpful in answering the questions they want to address. Students who are interested in conducting independent neuroscience research have several neuroscience labs from which to choose, and may also seek permission to carry out a neuroscience-relevant project in a lab that is not focused on neuroscience. Independent research is the best preparation for doctoral programs, and is also regarded highly by medical, dental and other life science professional schools. For this reason, getting an independent research position in a lab is competitive.

### Seminar Courses

There are three seminar style courses available to neuroscience undergraduates. In these courses, students tackle the primary literature and react to seminars given by neuroscientists on their research.

Molecular/Cellular Neuroscience majors are invited to take the 1 credit hour NEUR 300 (<https://catalog.luc.edu/search/?P=NEUR%20300>) Seminar in Neuroscience course, providing basic exposure to the primary literature and a wide range of research talks. Both major tracks culminate in a required capstone seminar class, which immerses the students in the primary literature and encourages development of critical thinking and presentation skills.

## College of Arts and Sciences Graduation Requirements

All Undergraduate students in the College of Arts and Sciences are required to take two Writing Intensive courses (6 credit hours) as well as complete a foreign language requirement at 102-level or higher (3 credit

hours) or a language competency test. More information can be found here (<https://www.luc.edu/cas/college-requirements/>).

## Additional Undergraduate Graduation Requirements

All Undergraduate students are required to complete the University Core, at least one Engaged Learning course, and UNIV 101. SCPS students are not required to take UNIV 101. Nursing students in the Accelerated BSN program are not required to take core or UNIV 101. You can find more information in the University Requirements (<https://catalog.luc.edu/undergraduate/university-requirements/>) area.

## Learning Outcomes

By the end of this program of study, students will be able to:

- functional neuroanatomy at the gross, cellular, and subcellular levels. [Neuroanatomy]
- electrochemical signaling and information processing in the nervous system. [Neurophysiology]
- the general methodological approaches, applications, strengths, and weaknesses of the major laboratory and computational techniques used in the study of the nervous system. [Neuroscience Methods]
- the neural bases of sensory processing and behavior (e.g., movement, appetitive behaviors, biological rhythms). [Sensory/Behavior]
- the neural bases of cognitive and affective aspects of mental life (e.g., memory, attention, executive function, language, emotion). [Cognitive/Affective]
- genetic, environmental, and experiential influences on neural development and neuroplasticity. [Neural Development/Plasticity]
- the relationships between neurological and psychiatric disorders (e.g., Alzheimer's disease, Parkinson's disease, schizophrenia, depression), their underlying neuropathology, and common treatments. [Clinical Disorders]
- read, understand, critically evaluate, and draw appropriate conclusions from reports of neuroscientific investigations. [Critical Analysis]
- effectively communicate findings from neuroscience research studies to both scientific and nonscientific audiences in multiple formats. [Scientific Communication]
- formulate scientific questions, construct testable hypotheses, and design scientific investigations that contribute to neuroscience. [Research Design]
- engage in scientific investigations using appropriate neuroscientific laboratory or computational techniques, statistically analyze the data, and interpret the findings. [Laboratory Skills & Inquiry/Statistical Analysis]
- develop awareness of the philosophical, moral, and ethical issues raised by neuroscience and influences of neuroscience on other fields such as medicine, education, and social sciences. [Science & Society]