

# NEUROSCIENCE & COGNITIVE SCIENCE

## Emphasis Descriptions & Course Listings

Updated April 2017

In addition to the NSCS foundation and core courses, students will complete a set of elective courses within the major. The NSCS electives have been separated into emphases – groups of thematically related upper division courses that are designed to help students explore in greater depth a subfield of neuroscience and cognitive science. **PLEASE NOTE:**

1. There may be courses offered in other departments of the university that would fit well into one or more of the emphases. We encourage students to notify us if they feel that they have identified one of these courses. With faculty approval, these courses can be included in the appropriate emphasis (or emphases).
2. Lab research is strongly encouraged in the NSCS program. Students may apply up to 6 units of upper-division research credit toward their emphasis requirement. Internships, preceptorships (max 3 units) and thesis credit may also be counted toward the emphasis electives in place of research credit.
3. DO YOUR PLANNING EARLY!! Not all of the courses listed for an emphasis will be offered every semester, or even every year, some have their own pre-requisites and some have limited enrollment. Some of the pre-requisites listed in this document are specific to NSCS students and will not necessarily reflect the pre-requisites listed in the course catalog.
4. A course preceded by “*or*” indicates that only one course in that particular set of courses may count toward the emphasis.
5. Some courses are listed as both core and emphasis courses. These courses *cannot* double-dip and fulfill both requirements. A separate course must be taken for each requirement area.

### Cognition

*The courses in this emphasis focus on higher-order functions in the brain including decision making, reasoning, language, attention, perception, memory, and consciousness; the development of these functions; and the brain mechanisms responsible for them. Courses also cover the brain disorders that disrupt cognitive functioning. This emphasis is expected to be especially attractive to students contemplating careers in medicine, law, business, marketing, research and teaching, neuro-rehabilitation, or social and home care services.*

Course	Units	Typically Offered	Prerequisites
ECOL 346 – Bioinformatics	4	Spring	ECOL 320 or ECOL 326 or MCB 304
ISTA 457 – Neural Networks	3	Spring	NSCS 344, MATH 313 recommended
LING 432 – Psychology of Language	3	Fall, Spring, Sum	LING 201 or PSY 101
NROS 412 – Molecular Mechanisms of Learning and Memory	3	Fall	NROS 307
NROS 415 – Electrophysiology Lab	3	Spring	NSCS 315B <i>or</i> NROS 307 <i>or</i> NROS 310
NSCS 344 – Modeling the Mind: Comp Models of Cognition	3	Spring	Intro programming & stats
PHIL 439 – Decision Theory	3	Spring	PHIL 241
PHIL 442 – Knowledge and Cognition	3	Fall and Spring	PHIL 241
PSY 300 – Cognitive Neuroscience	3	Fall, Spring, Sum	PSY 101 or PSY 150A1
PSY 313 – Drugs and the Brain	3	Varies	PSY 101 or PSY 150A1 and statistics
PSY 325 – Cognitive Psychology (replaced with PSY 300)	3	Discontinued 2016	PSY 101 or PSY 150A1
PSY 326 – Human Memory	3	Spring, Sum	PSY 101 or PSY 150A1
PSY 329 – Sensation and Perception	3	Varies	PSY 101 or PSY 150A1
PSY 333 – Judgment and Decision-Making	3	Spring	PSY 101 or PSY 150A1
PSY 340 – Introduction to Cognitive Development	3	Fall, Spring, Sum	PSY 101 or PSY 150A1
PSY 358 – Psychology of Consciousness	3	Varies	PSY 101 or PSY 150A1
PSY 405 – Developmental Cognitive Neuroscience	3	Fall	PSY 101 or PSY 150A1
PSY 412 – Animal Learning	3	Fall	PSY 101 or PSY 150A1
PSY 426 – Advanced Human Memory	3	Every other Fall	PSY 300 or PSY 325 or PSY 326
PSY 433 – Neuroeconomics	3	Fall	PSY 101 or PSY 150A1 and NSCS 200
PSY 478 – Sleep and Sleep Disorders	3	Spring	PSY 101 or PSY 150A1
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## Cognition continued

PSY 496F – Cognitive Psychology	3	Spring	PSY 101 or PSY 150A1
PSY 596E – Biopsychology (grad course)	3	Varies	Senior or Honors junior – permission of instructor
SLHS 420 – Cognitive Neuroscience of Hearing	3	Varies	none listed
SLHS 430 – Cognitive Neuroscience of Language	3	Spring	none listed
UD Research/Internship/Preceptorship/Thesis - Max 6 units -Upper-division research, internship, preceptorship (max 3 units), thesis			

## Computation

*This emphasis is intended for students who are strong in mathematics and whose career paths likely will include work with complex systems. The study of brain and behavior has become increasingly complex and multi-disciplinary, and modeling and data mining are often used as key methods of study while experimental interpretation often requires sophisticated data analysis methods. This emphasis would be a good entre to careers in many subfields of neuroscience and cognitive science, including electrophysiology and biophysics, bioengineering, imaging and robotics.*

### Quantitative foundation – complete one course

Course	Units	Typically Offered	Prerequisites
ECE 220 – Basic Circuits	5	Fall, Spring, Sum	MATH 129, PHYS 241. Concurrent registration, MATH 254
ISTA 311 – Foundations of Information & Inference	3	Spring	ISTA 116, MATH 263, or equivalent. One of CSC 245, MATH 215 or MATH 243.
MATH 129 – Calculus II	3	Fall, Spring, Sum	Appropriate Math Placement Level
MATH 254 – Introduction to Ordinary Differential Equations	3	Fall, Spring, Sum	MATH 129, 223 or 250A with C or better.
MATH 355 – Analysis of Ord. Differential Equations	3	Fall and Spring	Appropriate Math Placement Level or MATH 215
PHYS 141– Introductory Mechanics & PHYS 241 – Introductory Electricity and Magnetism	8	Fall, Spring, Sum	MATH 122A&B, MATH 124 or MATH 125; Concurrent registration, MATH 129
PHYS 431 – Molecular Biophysics	3	Fall	CHEM 103A; PHYS 103; CHEM 103B or equivalent.

### Computation Emphasis – complete 12 units

Course	Units	Typically Offered	Prerequisites
BME 417 -- Measurement and Data Analysis in Biomedical Engineering	3	Spring	none listed
ECOL 346 – Bioinformatics	4	Spring	ECOL 320 or ECOL 326 or MCB 304
ISTA 321 - Data Mining and Discovery	4	Fall	ISTA 116 or similar statistics course; ISTA 130 or equivalent programming course.
ISTA 410 - Bayesian Modeling and Inference	3	Spring	ISTA 130 (or equivalent programming course), MATH 215 (Linear Algebra), ISTA 116 or ISTA 521
ISTA 421 - Introduction to Machine Learning	3	Fall	Calculus I and II, linear algebra, basic programming. Statistics or probability course.
ISTA 450 - Artificial Intelligence	3	Spring	C SC 345 or equivalent or consent of instructor. Probability and statistics helpful but not required.
ISTA 454 - Informatics in Biology	3	Spring	Either ECOL 182R or ISTA 130 or other programming course. At least junior standing.
ISTA 457 – Neural Networks	3	Spring	NSCS 344 or ISTA 350 or CSC 345. MATH 313 recommended
MATH 475A - Math Prin. of Numerical Analysis	3	Fall	(MATH 254, 355 or 250B) and MATH 215.
MATH 485 - Mathematical Modeling	3	Spring	(MATH 254, 355 or 250B) and MATH 215.
NROS 415 – Electrophysiology Lab	3	Spring	NSCS 315B <b>or</b> NROS 307 <b>or</b> NROS 310
NSCS 344 – Modeling the Mind: Computational Models of Cognition	3	Spring	Intro programming & stats
PHIL 455 - Philosophy and Artificial Intelligence	3	Varies	none listed
PSIO 472 - Quantitative Modeling of Biological Sys	3	Fall	MATH 129

UD Research/Internship/Preceptorship/Thesis - Max 6 units -Upper-division research, internship, preceptorship (max 3 units), thesis

## Language and Communication Science

*This emphasis focuses on the neurobiology and cognitive science of language and communication. While strongly oriented toward human language and communication, courses in the emphasis also may include studies on communication in other species. This emphasis will prepare students to use their knowledge in fields as diverse as education, neurorehabilitation, social services, research, and government policy making.*

Course	Units	Typically Offered	Prerequisites
LING 300 – Introduction to Syntax	3	Fall and Spring	LING 201
LING 315 – Introduction to Phonology	3	Fall and Spring	LING 201
LING 322 – The Structure & Meaning of Words	3	Fall, Spring, Sum	none listed
LING 341 – Language Development	3	Fall, Spring, Sum	PSY 101 or PSY 150A1
LING 364 – Introduction to Formal Semantics	3	Spring	none listed
LING 388 – Language & Computers	3	Spring	LING 201
LING 432 – Psychology of Language	3	Fall, Spring, Sum	LING 201 or PSY 101 or PSY 150A1
LING 449A – Bilingualistics	3	Spring	none listed
SLHS 340 – Language Science	3	Fall, Sum	none listed
SLHS 362 – Neurobiology of Communication	3	Fall	none listed
SLHS 380 – Hearing Science	4	Spring	SLHS 267
SLHS 420 – Cognitive Neuroscience of Hearing	3	Varies	none listed
SLHS 430 – Cognitive Neuroscience of Language	3	Spring	none listed
SLHS 441 – Language Acquisition	3	Spring	SLHS 340
SLHS 473 – Communication Disorders II	3	Spring	SLHS 340 and SLHS 477
SLHS 477 – Communication Disorders I	3	Fall	SLHS 261 and SLHS 267
UD Research/Internship/Preceptorship/Thesis - Max 6 units -Upper-division research, internship, preceptorship (max 3 units), thesis			

## Neurobiology

*The courses in this emphasis focus on the molecular, genetic, and cellular bases of neural function, but extend to the behavioral outcome of activity in neural circuits. Students in this emphasis are likely to follow a path to graduate school or medical school or to careers in biotechnology, non-profit research foundations, or science writing.*

Course	Units	Typically Offered	Prerequisites
ECOL 346 – Bioinformatics	4	Spring	ECOL 320 or ECOL 326 or MCB 304
ECOL 487R/L – Animal Behavior w/lab	4	Fall	MCB 181 R/L and ECOL 182 R/L
<b>or</b> NROS 381 – Animal Brains, Signals, Sex, and Social Behaviors	3	Spring	None
ISTA 457 – Neural Networks	3	Spring	NSCS 344 or ISTA 350 or CSC 345. MATH 313 recommended
NROS 330 - Principles of Neuroanatomy: Cells to Systems	3	Fall	NSCS 200, NROS 307 (concurrent ok) or consent of instructor
NROS 412 – Molecular Mechanisms of Learning and Memory	3	Fall	NROS 307
NROS 415 – Electrophysiology Lab	3	Spring	NSCS 315B <b>or</b> NROS 307 <b>or</b> NROS 310
NROS 430 – Neurogenetics	3	Spring	MCB 181R, NROS 310 recommended
NSCS 344 – Modeling the Mind: Computational Models of Cognition	3	Spring	Intro programming & stats recommended
NSCS 450 - Neurons and Glia in Health and Disease	3	Spring	NROS 307 and NSCS 315B
PHYS 431 – Molecular Biophysics	3	Spring	PHYS 103 or equivalent
PSY 313 – Drugs and the Brain	3	Varies	PSY 101 or PSY 150A1 and statistics
PSY 485 - Psychoneuroimmunology	3	Every other Fall	none listed
UD Research/Internship/Preceptorship/Thesis - Max 6 units -Upper-division research, internship, preceptorship (max 3 units), thesis			

## Development and Aging

*This emphasis includes courses that allow a student to explore changes in the brain that accompany development and aging. It focuses on research, the increasingly sophisticated understanding of normal development and aging, and newly developing approaches to prevention, treatment, and optimization of levels of functioning. Students in this emphasis will be prepared to engage in numerous fields such as medicine, social and home care services, neurorehabilitation, global health, government policy-making, non-profit agencies, and education of professionals and paraprofessionals who work with people who are developmentally disabled or aging. This is expected to be an area of increasing priority in the employment market as better treatment helps people with developmental disabilities live normal life spans and as the population as a whole ages.*

Course	Units	Typically Offered	Prerequisites
FCM 496D - Disability Perspectives in Research, Policy, and Practice	3	Fall	none listed
FSDH 413 – Issues in Aging	3	Fall and Spring	none listed
PSY 340 – Introduction to Cognitive Development	3	Fall, Spring, Sum	PSY 101 or PSY 150A1
PSY 405 – Developmental Cognitive Neuroscience	3	Fall	PSY 101 or PSY 150A1
PSY 424 – Gerontology: A Multidisc. Perspective	3	Varies	none
PSY 426 – Advanced Human Memory	3	Every other Fall	PSY 300 or 325 or 326
PSY 478 – Sleep and Sleep Disorders	3	Spring	PSY 101 or PSY 150A1
SLHS 340 – Language Science	3	Fall, Sum	none listed
SLHS 441 – Language Acquisition	3	Spring	SLHS 340
UD Research/Internship/Preceptorship/Thesis - Max 6 units -Upper-division research, internship, preceptorship (max 3 units), thesis			

## Philosophy of Mind

*This emphasis focuses on theoretical issues about the relation between the brain and the mind. Courses in this emphasis include study of fundamental issues in the philosophy of science, the investigation of neuroscientific explanations of consciousness, and the neural underpinnings of moral judgment. This emphasis is expected to be especially attractive to students interested in the foundations of cognitive science and in the philosophical problems surrounding cognitive science.*

Course	Units	Typically Offered	Prerequisites
PHIL 305 – Intro to Philosophy of Science	3	Fall, Spring, Sum	NSCS foundation courses completed
PHIL 345 – Philosophy and Psychiatry	3	Fall, Spring, Sum	NSCS foundation courses completed
PHIL 346 – Minds, Brains & Computers	3	Fall, Spring, Sum	NSCS foundation courses completed
PHIL 347 – Neuroethics	3	Fall, Spring, Sum	NSCS foundation courses completed
PHIL 348 – The Moral Mind	3	Fall, Spring, Sum	NSCS foundation courses completed
PHIL 376 – Intro to the Philosophy of Language	3	Fall	NSCS foundation courses completed
PHIL 437 – Moral and Social Evolution	3	Spring	NSCS foundation courses completed
PHIL 439 – Decision Theory	3	Spring	NSCS foundation courses completed
PHIL 442 – Knowledge & Cognition	3	Fall	NSCS foundation courses completed
PHIL 450 – Philosophy of Mind	3	Fall and Spring	NSCS foundation courses completed
PHIL 455 – Philosophy & Artificial Intelligence	3	Varies	NSCS foundation courses completed
PHIL 465 – Pragmatics	3	Spring	NSCS foundation courses completed
UD Research/Internship/Preceptorship/Thesis - Max 6 units -Upper-division research, internship, preceptorship (max 3 units), thesis			

## Thematic

*The thematic emphasis is meant for students who have a very clear and compelling interest in a particular topic area in neuroscience and cognitive science. As is the case for the other emphases, the overall learning objective is to develop real depth in a particular area that the students then can use in reaching their particular career goals. We will always consider the possibility of adding a course that is not currently on the course lists for the existing emphasis if doing so would expand or modify that emphasis enough to make it a better fit for your interests. If, on the other hand, you have a topic area that simply falls too far outside of any of the existing emphases, then we will work with you to develop a thematic emphasis. To be allowed to do a thematic emphasis, you will have to describe in some detail what the topic area is, convince us why the other emphases won't work, and tell us what the objectives of your course work will be. As with the other emphases, research and independent study credit can be used for up to 6 of the 15 credits required to complete an emphasis.*