Philosophy-Neuroscience-Psychology

Philosophy-Neuroscience-Psychology (PNP) is an interdisciplinary program that provides an opportunity to examine the mind from multiple perspectives. Students who choose to major in PNP will learn to bring some of the newest findings in science to bear on some of the oldest questions in philosophy; equally important, they will see new questions emerge and learn to pursue those as well. Examples include: Is the mind–brain a single entity, or does having a mind involve something over and above the activity of a brain? What assumptions are made by cognitive psychologists when they divide mental activity into separate processes and use response times or other measures of task performance to describe those processes? What assumptions are made by neuroscientists when they use imaging techniques to determine where in the brain a cognitive process is carried out? What are we to make of Chomsky’s claim that language is an innate mental organ designed to generate an infinite number of sentences? PNP majors will seek answers to questions such as these in courses offered by PNP and PNP’s affiliated departments.

Contact: PNP Office
Phone: 314-935-4297
Email: pnp@wustl.edu
Website: http://pnp.artsci.wustl.edu

Faculty

Director
Ron Mallon (http://philosophy.artsci.wustl.edu/people/ron-mallon)
Professor
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(Philosophy; Philosophy-Neuroscience-Psychology)

Core Faculty
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(Psychological & Brain Sciences)

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(Romance Languages and Literatures)

Cindy Brantmeier (http://rll.wustl.edu/people/brantmeier)
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(Romance Languages and Literatures; Education)
Todd S. Braver (http://psychweb.wustl.edu/people/todd-braver)
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Dennis DesChene (http://philosophy.artsci.wustl.edu/people/Dennis_DesChene)
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PhD, Stanford University
(Philosophy; Interdisciplinary Project in the Humanities)

Janet M. Duchek (http://psychweb.wustl.edu/people/janet-duchek)
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(Psychological & Brain Sciences)

Leonard Green (http://psychweb.wustl.edu/green)
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PhD, State University of New York–Stony Brook
(Psychological & Brain Sciences; Economics)

John Heil (http://philosophy.artsci.wustl.edu/people/John_Heil)
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PhD, Vanderbilt University
(Philosophy)

Erik Herzog (http://wubio.wustl.edu/herzog)
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PhD, Syracuse University, Institute for Sensory Research
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Lori Markson (http://psychweb.wustl.edu/markson)
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PhD, University of Arizona
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Kathleen McDermott (http://psychweb.wustl.edu/mcdermott)
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PhD, Rice University
(Psychological & Brain Sciences)

Camillo Padoa-Schioppa (http://thalamus.wustl.edu/cps)
Associate Professor
PhD, Massachusetts Institute of Tecnology
(Anatomy and Neurobiology; Biological Engineering)

Jonathan Peelle (http://jonathanpeelle.net)
Assistant Professor
PhD, Brandeis University
(Otolaryngology)

Anya Plutynski (http://philosophy.artsci.wustl.edu/people/anya-plutynski)
Associate Professor
PhD, University of Pennsylvania
(Philosophy)

Marcus E. Raichle (http://www.nil.wustl.edu/labs/raichle)
Professor
MD, University of Washington
(Radiology)

Andrew Rehfeld (http://polisci.wustl.edu/andrew_rehfeld)
Professor
PhD, University of Chicago
(Political Science)

Larry Snyder (http://thalamus.wustl.edu/O-bios/lhs)
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PhD, University of Rochester
(Anatomy and Neurobiology)

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Professor
PhD, University of Michigan
(Psychological & Brain Sciences)

Roy Sorensen (http://philosophy.artsci.wustl.edu/people/roy-sorensen)
Professor
PhD, Michigan State
(Philosophy)

Paul S.G. Stein (http://wubio.wustl.edu/stein)
Professor
PhD, Stanford University
(Biology)

Brian Talbot (http://philosophy.artsci.wustl.edu/people/brian-talbot)
Study Abroad Advisor; Lecturer
PhD, University of Southern California
JD, University of California, Berkeley
(Philosophy)

James Wertsch (http://anthropology.artsci.wustl.edu/wertsch_james)
Marshall S. Snow Professor in Arts & Sciences
PhD, University of Chicago
(Anthropology; American Culture Studies; Education; International and Area Studies)

Desirée A. White (http://psychweb.wustl.edu/white)
Professor
PhD, Washington University
(Psychological & Brain Sciences)
Jeffrey M. Zacks (http://psychweb.wustl.edu/zacks)
Professor
PhD, Stanford University
(Psychological & Brain Sciences)

**Endowed Professors**

**John Baugh** (http://anthropology.artsci.wustl.edu/baugh_john)
Margaret Bush Wilson Professor in Arts & Sciences
PhD, University of Pennsylvania
(African and African-American Studies; American Culture Studies; Anthropology; Education; English; Psychological & Brain Sciences)

**Pascal R. Boyer** (http://anthropology.artsci.wustl.edu/boyer_pascal)
Henry Luce Professor of Collective and Individual Memory
PhD, University of Paris–Nanterre
(Anthropology; Religious Studies)

**Maurizio Corbetta** (https://neuro.wustl.edu/biographies/maurizio-corbetta-md)
Norman J. Stupp Professor of Neurology
MD, University of Verona, Italy

**Steven E. Petersen** (https://neuro.wustl.edu/biographies/steven-petersen-phd)
James S. McDonnell Professor of Cognitive Neuroscience
PhD, California Institute of Technology
(Neurology; Neurological Surgery; Psychological & Brain Sciences)

**Henry L. Roediger III** (http://psychweb.wustl.edu/roediger)
James S. McDonnell Distinguished University Professor
PhD, Yale University
(Psychological & Brain Sciences; American Culture Studies)

**Rebecca Treiman** (http://psychweb.wustl.edu/treiman)
Burke and Elizabeth High Baker Professor of Child Developmental Psychology
PhD, University of Pennsylvania
(Psychological & Brain Sciences)

**Majors**

**The Major in Philosophy-Neuroscience-Psychology**

**I. Core Undergraduate Requirements for PNP**

Required for all students, regardless of track:

**Entry Sequence**
Choose one of the following:

- PNP Sequence
  - PNP 201 Introduction to the Cognitive Sciences or
    - Psych 301 Experimental Psychology
  or

- Mind, Brain, Behavior Sequence (MBB)
  - MBB 120A Introduction to Study of the Mind-Brain: Psychological, Biological and Philosophical Perspectives
  - MBB 122 Introduction to the Study of the Mind Brain II or PNP 200 Introduction Cognitive Science

**Core Philosophy Requirements**

**Prerequisites:**

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<td>Phil 102</td>
<td>Introduction to Scientific Reasoning</td>
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<td>or</td>
<td>Phil 120F</td>
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<td>or</td>
<td>Phil 125C</td>
<td>Great Philosophers</td>
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**Upper division:** Two courses at the 300 or 400 level.

Majors must take either

- PNP 315 Philosophy of Mind, or
- PNP 306 Philosophy of Language

and another from the list below:

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<td>Mind and Morals</td>
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<td>Phil 3481</td>
<td>Introduction to Metaphysics</td>
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<td>Phil 349C</td>
<td>Descartes to Hume</td>
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<tr>
<td>Phil 390</td>
<td>Philosophical Writing (upon approval of subject matter, consult PNP office for each semester)</td>
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<td>PNP 4065</td>
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<tr>
<td>Phil 410</td>
<td>Theories of Perception</td>
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PNP 4141 Advanced Epistemology 3  
PNP 4142 Advanced Metaphysics 3  
PNP 418 Current Controversies in Cognitive Science 3  
PNP 419 Philosophy of Psychology 3  
PNP 4210 Topics in Advanced Philosophy of Science 3  
Phil 4212 Philosophy of Neuroscience 3  
Phil 423 Philosophy of Biological Science 3  
PNP 426 Theories of Concepts 3  
PNP 4332 Cognition and Computation 3  
PNP 495 PNP Seminar 3  
PNP 496 PNP Seminar 3  

**II. Track-specific Requirements**

**Courses required for the Cognitive Neuroscience (CN) track**

**Prerequisites:** Biol 2960 or Psych 3401* and permission of instructor; Biol 3058 recommended.

**Upper division:** Two neuroscience courses at the 300 or 400 level. Students must take:

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<td>Psych 3604</td>
<td>Cognitive Neuroscience</td>
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(*Psych 3401 Biological Psychology can count toward the depth requirement in neuroscience, if taken as a prerequisite.)

**Courses required for the Language, Cognition and Culture (LCC) track**

**Prerequisites:**

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<td>Anthro 170D</td>
<td>Introduction to Linguistics</td>
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**Upper division:** Two courses at the 300 or 400 level, chosen from those below:

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<td>PNP 309</td>
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<td>PNP 3171</td>
<td>Introduction to Computational Linguistics</td>
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<tr>
<td>PNP 320</td>
<td>Historical and Comparative Linguistics</td>
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<tr>
<td>Anthro 3386</td>
<td>Language, Culture and Society</td>
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<td>Ling 339</td>
<td>Introduction to Sociolinguistics</td>
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<td>Psych 358</td>
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### Philosophy

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### Psychology

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<td>Introduction to Social Psychology</td>
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<td>PNP 3211</td>
<td>Developmental Psychology</td>
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<td>PNP 323</td>
<td>Play and Development</td>
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<td>Introduction to the Psychology of Aging</td>
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<td>PNP 330</td>
<td>Sensation and Perception</td>
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<td>PNP 3401</td>
<td>Biological Psychology</td>
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<td>PNP 3451</td>
<td>Genes, Environment, and Human Behavior</td>
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PNP 362  The Biological Basis of Human Behavior  3
PNP 3661 Science of Creativity  3
Psych 374  Drugs, Brain and Behavior  3
PNP 380  Human Learning and Memory  3
Psych 4046 Developmental Neuropsychology  3
PNP 408  Psychology of Language  3
PNP 4302 Cognitive Psychology Applied to Education  3
Psych 4182 Perception, Thought and Action  3
Psych 4361 Psychological Perspectives on the Self  3
Psych 4408 Trauma and Memory  3
Psych 4413 Advanced Cognitive Neuroscience (Writing Intensive)  3
PNP 4450 Functional Neuroimaging Methods  3
Psych 4591 The Development of Social Cognition  3
Psych 462  Psychology of Memory and Cognition  3
Psych 4625 Autobiographical Memory  3
Psych 4651 History and Modern Systems of Psychology  3
Psych 4745 Genes, Brain and Behavior: Pathways to Psychopathology  3
Psych 4765 Inside the Disordered Brain: Biological Bases of the Major Mental Disorders  3
PNP 495  PNP Seminar  3
PNP 496  PNP Seminar  3

Anthropology

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<td>PNP 406</td>
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<td>PNP 320</td>
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IV. Capstone

The Capstone is required for honors students and first majors; it is recommended for second majors. It consists of one of the following:

- A PNP Honors project (PNP 499, 6 units; requires PNP Honors form to be filled out and approved by Honors Coordinator).
- The 2-unit PNP Reading Class (formerly PNP Book Club) plus the PNP Seminar (PNP 495) of PNP 496
- The PNP Reading Class (formerly PNP Book Club) plus 3 advanced units of independent study, PNP 500. The independent study details are available on the PNP website (https://pnp.artsci.wustl.edu/undergraduate/independent-study).

Units from a capstone experience can count toward the depth requirement in either the CN or LCC tracks.

Minors

The Minor in Philosophy-Neuroscience-Psychology

Units required: 15

Required courses: Minors are required to complete at least 15 units, of which 9 must be at the 300 level or above.

The minor is composed of a 6-unit introductory sequence (PNP 200 and PNP 201, or MBB 120A and MBB 122), followed by:

- 3 units in Philosophy:
  - PNP 315 Philosophy of Mind/Phil 315
  - PNP 306 Philosophy of Language/Phil 306G
- 3 units of Neuroscience:
  - PNP 3411 Principles of the Nervous System/Biol 3411
  - Psych 3604 Cognitive Neuroscience

Additional Information

Psych 100B is the prerequisite for all psychological & brain science courses at the 300 level and above. Note that no more than 6 units counted toward a minor in PNP may be transferred or earned abroad, and no more than 3 units may be counted toward another major or minor.

Courses

Visit online course listings to view semester offerings for L64 PNP (https://courses.wustl.edu/CourseInfo.aspx?sch=L&dept=L64&crslvl=1:4).

L64 PNP 200 Introduction Cognitive Science

We seek to understand the mind-brain by integrating findings from several of the cognitive sciences, including philosophy, psychology, neuroscience, linguistics, anthropology and artificial intelligence. This course considers multiple perspectives on such topics as mental imagery, concepts, rationality, consciousness, emotion, language, thought, memory, attention and machine intelligence. Prerequisite: completion of at least one of the following courses: Psych 100B, Phil 120F, Phil 125C, Biol 296A, MBB 120A or Ling 170D.

Credit 3 units. A&S: SS A&S IQ: SSC Arch: SSC BU: HUM EN: S

L64 PNP 201 Inquiry in the Cognitive Sciences

Understanding the mind-brain involves orchestrating a variety of conceptual tools and modes of inquiry from the cognitive sciences. This course offers a hands-on introduction to a variety of research tactics used in the behavioral and biological sciences and emphasizes the advantages of combining them. For example, neuroimaging can enhance the interpretation of experiments by cognitive psychologists and modeling can be used to simulate and understand the effects of brain lesions. Prerequisite: completion of at least one of the following courses: Psych 100B, Phil 120F, Phil 125C, Biol 296A, MBB 120A or Ling 170D.

Credit 3 units. A&S: NS A&S IQ: NSM Arch: NSM BU: HUM EN: S

L64 PNP 3001 Research in the Mind, Brain, and Behavior

An introduction to research for students in the Mind, Brain and Behavior program (formerly known as Hewlett Program). Students work under the supervision of a mentor. Prerequisite: admission to the Mind, Brain and Behavior program, completion of MBB/PNP 122, and permission of the mentor.

Same as L96 MBB 300

Credit 3 units. A&S: NS A&S IQ: NSM Arch: NSM Art: NSM

L64 PNP 301 Symbolic Logic

In the first half of the course we study some features of truth-functional and first-order classical logics, including studying the model theory and meta theory for first-order logic in much greater
depth than in Phil 100. In the second half of the course we go on to study three different styles of proof-system: tableau, axiomatic, and natural deduction. This course continues on where Phil 100: An Introduction to Logic and Critical Analysis leaves off. It is recommended for students who have already taken that introductory course, or for students who already have a strong background in mathematics. Priority given to majors in philosophy and PNP.

Same as L30 Phil 301G
Credit 3 units. A&S: LA A&S IQ: NSM, AN Art: NSM BU: HUM

L64 PNP 306 Philosophy of Language
A survey of major philosophical problems concerning meaning, reference, and truth as they have been addressed within the analytic tradition. Readings that represent diverse positions on these focal issues will be selected from the work of leading philosophers in the field, for example: Frege, Russell, Wittgenstein, Davidson, Quine, Kripke, and Putnam. Students are encouraged to engage critically the ideas and arguments presented, and to develop and defend their own views on the core topics. Prerequisites: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP.

Same as L30 Phil 306G
Credit 3 units. A&S: LA A&S IQ: HUM Art: HUM BU: HUM

L64 PNP 309 Syntactic Analysis
The ability to produce and understand an infinite number of sentences is perhaps the most fascinating aspect of the human language faculty. Syntax is the study of how the brain organizes sentences from smaller phrases and words. This course explores syntactic analysis from several perspectives within generative linguistics, focusing primarily on the Government and Binding framework but also introducing Minimalist and Optimality Theoretic approaches. Topics include phrase structure, transformations, case theory, thematic roles and anaphora. Assignments help students learn to construct and compare analyses of syntactic problems in English and other languages. Prerequisite: Ling 170D or permission of instructor.

Same as L44 Ling 309
Credit 3 units. A&S: LA A&S IQ: SSC BU: HUM EN: S

L64 PNP 311 Introduction to Semantics
Semantics is the branch of linguistics which studies how speakers assign meaning to words, sentences, and larger units of discourse. We combine perspectives from both linguistics and philosophy to explore a variety of topics including polysemy, compositionality, quantification, anaphora, definite descriptions, attitude reports, presupposition and implicature. Prerequisite: Ling 170D or Phil 301G or permission of instructor.

Same as L44 Ling 311
Credit 3 units. A&S: LA A&S IQ: SSC Arch: SSC Art: SSC BU: HUM EN: S

L64 PNP 313 Phonological Analysis
There are several important abilities involved in the use of human language, one of these being the ability to organize speech sounds. The system that the brain uses to accomplish this task is the subject matter of phonology. This course explores phonology from several perspectives within generative linguistics, including both traditional rule-based and current Optimality Theoretic approaches. Topics discussed include phonological features, lexical phonology, prosodic morphology, tone, and metrical stress. Assignments help students learn to analyze phonological problems in a variety of languages and to evaluate the consequences of using different analytic approaches. Prerequisite: Ling 170D or permission of instructor.

Same as L44 Ling 313
Credit 3 units. A&S: LA A&S IQ: SSC BA: BU EN: S

L64 PNP 315 Philosophy of Mind
An introduction to philosophical analyses of the nature of mind, especially those developed by contemporary philosophers. The focus will be on questions such as the following: What is a mind? How does it relate to a person’s brain? How does it relate to a person’s body and the external world? Can a mind exist in a very different kind of body (e.g., a computer or a robot)? Does thinking require a language-like code? If so, can non-linguistic species think? What is it to have a mental image or to experience pain? Prerequisite: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP.

Same as L30 Phil 315

L64 PNP 3151 Introduction to Social Psychology
Introduction to the scientific study of individual behavior in a social context. Topics: person perception, stereotyping and prejudice, attitudes, memory, and political psychology, among other issues. Prerequisite: Psych 100B.

Same as L33 Psych 315
Credit 3 units. A&S: SS A&S IQ: SSC Arch: SSC Art: SSC BU: BA EN: S

L64 PNP 316 Mind and Morals
This course explores a number of issues at the intersection of ethics and cognitive science. Possible topics include: Are human animals worthy of moral consideration? If brain activity is determined by causal laws, can we have free will? Prerequisite: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP.

Same as L30 Phil 316
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM BU: ETH

L64 PNP 3171 Introduction to Computational Linguistics
Use of computers to analyze, understand, and generate human language. Emphasis on appreciating practical applications such as text analysis, search and creation of dictionaries and corpora, information retrieval, machine translation, and speech interfaces. Survey of rule-based and statistical techniques. Students acquire programming skills appropriate for solving small- to medium-scale problems in linguistics and text processing, using a language such as Python. Students have regular programming assignments and complete a semester project. No previous knowledge of programming required. Prerequisite: Ling 170D.

Same as L44 Ling 317
Credit 3 units. A&S: LA A&S IQ: SSC EN: H, S
L64 PNP 320 Historical and Comparative Linguistics
Historical linguistics focuses on how languages change over time. Comparative linguistics focuses on their similarities and differences. In this course we trace some of the differences and changes in sound (phonetics and phonology), word formation (morphology), sentence structure (syntax), and meaning (semantics). Topics include linguistic universals, the structural and genetic classification of languages, the techniques of reconstructing proto-languages, and the causes of language change. Examples from Indo-European languages (for example, Greek, English, and Spanish) and from Native American languages (for example, Quechua and Mayan) are emphasized. Prerequisite: Ling 170D.
Same as L44 Ling 320
Credit 3 units. A&S: LA A&S IQ: LCD, SSC Art: HUM BU: HUM EN: S

L64 PNP 321 Philosophy of Science
Pivotal concepts common to empirical sciences are examined and clarified. These include: explanation, confirmation, prediction, systematization, empirical significance, and the relationship of all these concepts to the structure of scientific theory. Examples may be drawn from both contemporary and historical science, including the social, biological, and physical sciences. Students with a background in science are particularly encouraged to consider this course. Priority given to majors in philosophy and PNP.
Same as L30 Phil 321G

L64 PNP 3211 Developmental Psychology
This course concentrates on the cognitive and social development of the person from conception to adolescence. Topics covered include: infant perception, attachment, cognitive development from Piagetian and information processing perspectives, aggression and biological bases of behavior. Prerequisite: Psych 100B.
Same as L33 Psych 321
Credit 3 units. A&S: SS A&S IQ: SSC Arch: SSC Art: SSC BU: BA

L64 PNP 3221 Music Cognition
An introduction to modern research on music perception and cognition. The course covers four main topics: the perception of key, the psychoacoustics of dissonance, the relationship between attention and musical meter, and the process by which melodies establish, fulfill, and deny expectations. Students read and discuss research from both cognitive science and music theory, in addition to completing several projects.
Same as L27 Music 3221
Credit 3 units. A&S: NS A&S IQ: NSM Arch: NSM Art: NSM BU: HUM

L64 PNP 323 Play and Development
An examination of current research and theory in play, in development and education, from infancy through the early school years. Topics include play and the development of language, social skills, creativity, and cognitive abilities. We will also examine the uses of play in educational contexts, focusing on preschool and the early primary grades. Prerequisite: Psych 321 (Developmental Psychology) or Educ 304 (Educational Psychology).
Same as L12 Educ 337
Credit 3 units. A&S: SS A&S IQ: SSC BU: BA EN: S

L64 PNP 330 Sensation and Perception
What's involved in seeing and hearing? This course covers perceptions from the physical stimuli (light and sound) that impinge upon the sensory receptors through the higher-level perceptual processes that the stimuli generate. Demonstrations and illusions are used as we learn about the anatomy and physiology of the sensory systems, and study the brain mechanisms that are involved in vision and audition. Prerequisite: Psych 100B.
Same as L33 Psych 330
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: BA, SCI

L64 PNP 3401 Biological Psychology
An introduction to biological mechanisms underlying behavior. Topics include the physiology of nerve cells, anatomy of the nervous system, control of sensory and motor activity, arousal and sleep, motivation and higher mental processes. Prerequisite: Psych 100B.
Same as L33 Psych 3401
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI

L64 PNP 3411 Principles of the Nervous System
The basic anatomical, physiological, and chemical organization of the nervous system; how nerve cells communicate with each other, the ionic basis of nerve signals, the function and properties of chemical agents in the nervous system, the development of neural circuitry, and how neurons interact to produce behavior. Prerequisite: Biol 2960, Biol 2970 recommended, Biol 3058 recommended or Psych 3401 and permission of instructor.
Same as L41 Biol 3411
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI

L64 PNP 3451 Genes, Environment, and Human Behavior
This class will examine how genetic influences impact various dimensions of human behavior, ranging from traits (e.g., personality) to psychiatric disorders. Topics to be covered include methods used to study genetic influence, how genetic predispositions interact with the environment, and ethical implications. Modern methods for gene-identification, such as genomewide association studies, polygenic risk scores and epigenetic experiments will be examined in detail. Emphasis will be placed on understanding core concepts (e.g., what is identity-by-descent) as well as application (e.g., calculate heritability, interpretation of results from published studies). Prerequisite: Psych 100B.
Same as L33 Psych 345
Credit 3 units. A&S: SS A&S IQ: SSC Arch: SSC Art: SSC BU: BA EN: S

L64 PNP 350 Physics of the Brain
Concepts and techniques of physics are applied to study the functioning of neurons and neuronal circuits in the brain. Neurons and neural systems are modeled at two levels: (i) at the physical level, in terms of the electrical and chemical signals that are generated and transmitted and (ii) at the information-processing level, in terms of the computational tasks performed. Specific topics include: neuronal electrophysiology, neural codes, neural plasticity, sensory processing, neural network architectures and learning algorithms, and neural networks as dynamical and statistical systems. Course grade is based
primarily on an individualized term project. Prerequisite: Physics 117A-118A, Physics 197-198, or permission of the instructor. Same as L31 Physics 350
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI EN: SU, TU

L64 PNP 3531 Psychology of Personality
Review of basic theoretical orientations to the understanding of personality and complex human behavior. Overview of related techniques, procedures, and findings of personality assessment and personality research. Discussion of critical issues in evaluation of personality theories. Prerequisite: Psych 100B.
Same as L33 Psych 353
Credit 3 units. A&S: SS A&S IQ: SSC Arch: SSC Art: SSC BU: BA

L64 PNP 3541 Abnormal Psychology
This is an introductory course in psychopathology or the scientific study of mental health disorders. The course includes definitions, theories and classification of abnormal behavior. Content focuses on symptoms, classification, prevalence, etiology, and treatment of mental health disorders, including mood, anxiety, eating, schizophrenia spectrum, substance use and personality disorders. Prerequisite: Psych 100B.
Same as L33 Psych 354
Credit 3 units. A&S: SS A&S IQ: SSC Arch: SSC Art: SSC BU: BA EN: S

L64 PNP 355 Physics of Vision
How do the eyes capture an image and convert it to neural messages that ultimately result in visual experience? This lecture and demonstration course covers the physics of how we see. The course is addressed to physics, pre-medical, and life-sciences students with an interest in biophysics. Topics include physical properties of light, evolution of the eyes, image formation in the eye, image sampling with an array of photoreceptors, transducing light into electrical signals, color coding, retinal organization, computing with nerve cells, compressing the 3-D world into optic nerve signals, inferring the 3-D world from optic nerve signals, biomechanics of eye movement, engineered vision in machines. The functional impact of biophysical mechanisms for visual experience are illustrated with psychophysical demonstrations. Corequisite: Physics 117A, Physics 197 or permission of instructor.
Same as L31 Physics 355
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI EN: TU

L64 PNP 3581 Conceptual Foundations of Modern Science
The aim of this course is to present some of the basic concepts underlying modern science. Insofar as many of those concepts first appeared or became predominant in the seventeenth and early eighteenth centuries, the course concentrates on primary works from that period. Among the concepts to be studied are: 1. Nature and natures: the ontology of matter and force; causal closure. 2. Methods: observing and intervening, systematic and organized. 3. Explanations: appeal to laws and mechanisms, teleology. Prerequisite: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP.
Same as L30 Phil 358
Credit 3 units. A&S: TH A&S IQ: HUM BU: HUM EN: H

L64 PNP 360 Cognitive Psychology
Introduction to the study of thought processing from an information-processing approach. Emphasis on theoretical models grounded in empirical support. Topics include pattern recognition, attention, memory, reasoning, language processes, decision-making and problem-solving. Prerequisite: Psych 100B.
Same as L33 Psych 360
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: BA

L64 PNP 361 Psychology of Learning
Basic learning processes in animals, such as conditioning, reinforcement, punishment, and constraints on learning. Comparisons and interactions between classical and operant conditioning. Consideration given to learning theorists and theories, along with applications from the laboratory to the "real world." Prerequisite: Psych 100B.
Same as L33 Psych 361
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: BA

L64 PNP 3611 Philosophy of Emotions
Introduction to anatomy and physiology of the peripheral hearing system and central nervous system, including functional descriptions of the systems and processes underlying speech and hearing function and dysfunction.
Same as M89 PACS 401
Credit variable, maximum 3 units.

L64 PNP 362 The Biological Basis of Human Behavior
Infidelity, marriage customs, inner city violence, infanticide, intelligence...Are the behavioral patterns we see genetically fixed and racially variable? What is the evolutionary and biological basis of human behavior? This course offers a critical evaluation of these from an anthropological perspective.
Same as L48 Anthro 362
Credit 3 units. A&S: NS, CD, SD A&S IQ: LCD, NSM, SD Arch: NSM Art: NSM BU: BA

L64 PNP 366 Art and the Mind-Brain
In recent years, there has been a growing interest in the bearing of cognitive science on the perception and understanding of art. This interest has roots in tradition: historically, art, aesthetics, and vision science have often been linked. But the growth of knowledge in cognitive science has opened up new opportunities for understanding art and addressing philosophical questions. The converse is also true. The production, perception, and understanding of art are human capacities that can shed light on the workings of the mind and brain. This course considers questions such as: What is art? How do pictures represent? Does art express emotion? Why does art have a history? Prerequisite: one course in Philosophy at the 100 or 200 level, or permission of the instructor. Priority given to majors in philosophy and PNP.
Same as L30 Phil 366
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM BU: HUM

L64 PNP 3661 Psychology of Creativity
This course is an introduction to the psychological study of art and creativity. Our topics include the artist, the audience, the artistic product, the creative process, and social, cultural, and institutional influences on the creative process. We will explore these issues by considering a range of creative fields, including painting, literature, music and theater performance. Throughout the semester, we will take a developmental perspective on
L64 PNP 3662 Primate Biology
This course takes a multifaceted introductory approach to the primates, the closest relatives of human beings, by investigating anatomy, growth and development, reproduction, behavioral adaptations, ecology, geographic distribution, taxonomy and evolution. Emphasis is placed not only on the apes and monkeys, but also on the lesser-known lemurs, lorises, bushbabies, tarsiers and many others. The importance of primate biology to the discipline of anthropology is discussed. Intended for students who have already taken Anthro 150A, and recommended for students who wish to take the more advanced 400-level courses on primates. Prerequisite: Anthro 150A or permission of instructor.
Same as L4A Anthro 366I
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: SCI

L64 PNP 3701 Introduction to Hispanic Linguistics
An introduction to the scientific study of the Spanish language, this course focuses on each of the major linguistic subsystems, including the sound system (phonetics and phonology), word formation (morphology), formation of phrases and sentences (syntax), and the use of the language to convey meaning (semantics and pragmatics). At each level of analysis, selected comparisons are made between Spanish and English and between Spanish and other languages. The course also examines different historical, regional and social varieties of Spanish and situations of Spanish in contact with other languages. The course also examines the interface between language and culture.
Same as L38 Span 370
Credit 3 units. A&S: LA A&S IQ: LCD BU: HUM EN: H

L64 PNP 380 Human Learning and Memory
A survey of issues related to the encoding, storage and retrieval of information in humans. Topics include memory improvement strategies, people with extraordinary memories, memory illusions and distortions, among other topics. Limited to 25 students. Prerequisite: Psych 100B.
Same as L33 Psych 380
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM BU: BA

L64 PNP 390 PNP Reading Class
Each time this course is offered a book is selected that does an exemplary job of bringing together insights and results from multiple disciplines in targeting an important topic. We read and discuss the book and possibly a small amount of supplementary reading. A short presentation and paper are required. Prerequisite: PNP major standing.
Credit 2 units. A&S: SS A&S IQ: SSC BU: HUM EN: S

L64 PNP 396 Linguistics Seminar: Pragmatics in Second Language Learning
Readings on a selected topic in theoretical linguistics with an emphasis on discussion, presentation and writing. Prerequisite: varies with topic.
Same as L44 Ling 396
Credit 3 units. A&S: TH A&S IQ: SSC EN: S

L64 PNP 402 The Physiology and Biophysics of Consciousness
This course will explore the questions surrounding the search to understand the physical substrate of consciousness. Some areas to be explored: 1. Can consciousness be addressed like any other biological property in the sense that it has evolved by natural selection and that some elements of it are present in simple model systems, such as the fruit fly? Can insight be gained studying simple model systems? 2. Where in the brain is consciousness? What is the pattern of neurological events that occurs during consciousness? Is brain activity generating consciousness localized or distributed? Does it involve interacting brain regions? Does brain activity generating consciousness migrate to different brain regions? 3. How does the dynamic core hypothesis of Edelman relate to these questions? What can functional brain imaging add to these questions? Are Gamma waves involved in higher mental activity, and do they promote synchronized firing of neurons from different brain areas? How does this relate to the binding problem? 4. How does the brain’s ability to function as a computer relate to consciousness? In many respects the brain functions as a computer using electrical signals called Action Potentials. Action potentials in neuronal networks function in an analogous way as DC electrical impulses function in computer circuits. What is the output of computation in an electrical device? What are the theoretical limitations regarding what computation can achieve and ask whether electrical activity in the brain also has a fundamentally different purpose in addition to computation. 5. Is our knowledge of the physical world too primitive and incomplete to understand consciousness? The brain is an electronic device and consciousness clearly depends on its electrical activity. Yet, electrical forces are poorly understood, both in the context of classical physics and quantum physics. Will understanding consciousness have to wait for a unified theory that more accurately describes electrical forces? Taught in the medical school: McDonnell Science Building 983. Prerequisites: Bio3411 or equivalent. College-level physics, some knowledge of computers.
Credit 2 units. A&S: NS A&S IQ: NSM

L64 PNP 4023 Models of Social Science
What distinguishes the social sciences from the natural sciences? What goals and assumptions do they share? Does studying “humans” with free will pose any problems for applying the methods of the natural sciences to the study of society? How do various social sciences — in particular anthropology, economics and political science — differ from one another? And where did the social sciences (both the disciplines and the conceptual issues) come from historically? These are the animating questions of this course. This class explores these questions in historical and contemporary perspective, as they relate to the rise of the social sciences as a set of academic disciplines. We set out the theoretical structure of the scientific method, paying particularly close attention to the relationships between theory and evidence, inference and hypotheses. Next we consider four problems and methods of the social sciences. These include questions of i) treating human beings as a rational
### L64 PNP 404 Laboratory of Neurophysiology
Neurophysiology is the study of living neurons. Students record electrical activity of cells to learn principles of the nervous system including sensory transduction and coding, intercellular communication and motor control. The course meets for 9 hours each week. Students may leave the lab for up to 2 hours. Prerequisites: Biol 3411 or Psych 4411 and permission of Student Coordinator, Erin Gerrity. Biol 3411 may be taken concurrently.
Same as L41 Biol 404
Credit 3 units. A&S: NS, WI A&S IQ: NSM, WI Art: NSM

### L64 PNP 4041 Math Logic II
Godel's Incompleteness Theorem: its proof, its consequences, its reverberations. Prerequisite: Philosophy 403 or a strong background in mathematics.
Same as L30 Phil 404
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM

### L64 PNP 406 Primate Ecology and Social Structure
Survey of the ecology, individual and social behavior, adaptations, and interactions of the major groups of primates. Emphasis on studies designed to examine the relationships among ecology, morphophysiology, and behavior. Methods used in collecting data on primates in the field. Prerequisite: Anthro 150A or one 100-level biology course.
Same as L48 Anthro 406
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM

### L64 PNP 4065 Advanced Philosophy of Language
An advanced-level treatment of basic topics in the philosophy of language as this discipline is understood in the analytic tradition. The main positions and the problems they pose are surveyed; focal themes include meaning, reference and truth. The aim of the course is to help students develop effective expository techniques and to provide them with the necessary conceptual resources to analyze and criticize different theoretical views. Prerequisite: one course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Same as L30 Phil 4065
Credit 3 units. A&S: LA A&S IQ: HUM Art: HUM

### L64 PNP 408 Psychology of Language
This course surveys current research and theory in psycholinguistics, covering the biological bases, cognitive bases and learning of language. We consider studies of normal children and adults, the performance of individuals with various types of language disorders, and computer simulations of language processes. Topics range from the perception and production of speech sounds to the management of conversations. Each student carries out an original research project on some aspect of psycholinguistics. Prerequisites: Ling 170D and Psych 100B. Same as L33 Psych 433

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Credit 3 units. A&S: SS A&S IQ: SSC Art: SSC

### L64 PNP 4141 Advanced Epistemology
Competing theories of knowledge and belief justification are considered. Careful attention is given to selected problems such as skepticism, certainty, foundations, coherence, perception, induction. Prerequisite: one course in Philosophy at the 300 level, graduate standing or permission of the instructor.
Same as L30 Phil 4141
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM

### L64 PNP 4142 Advanced Metaphysics
Through readings from both classical and contemporary sources, a single traditional metaphysical concern will be made the subject of careful and detailed analytic attention. Possible topics include such concepts as substance, category, cause, identity, reality and possibility, and such positions as metaphysical realism, idealism, materialism, relativism and irrealism. Prerequisites: one course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Same as L30 Phil 4142
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM

### L64 PNP 418 Current Controversies in Cognitive Science
An advanced survey of current debates in cognitive science with an emphasis on the philosophical issues raised by these debates. Topics may include: evolutionary psychology; innateness and neural plasticity; perception and action; consciousness; connectionism; robotics; embodied cognition; moral reason; emergence and artificial life; concepts and content; animal cognition. Prerequisites: one course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM

### L64 PNP 419 Philosophy of Psychology
An investigation of the philosophical presuppositions and implications of various traditions in psychology, including behaviorism, Gestalt and cognitivism, with a special emphasis on the development of the information processing approach of contemporary cognitivism. The conception of psychological phenomena, data and explanation central to each of these traditions are examined, and typical topics include the debates between propositional and imagistic models of representation, different accounts of concepts and categorization, and the relation of psychology to ethics. Prerequisite: one previous course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Same as L30 Phil 419
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM

### L64 PNP 4190 Primate Behavior
Discussion and analysis of recent research on the social behavior of nonhuman primates. Data from both field and laboratory study. Prerequisite: Anthro 406, or permission of instructor.
Same as L48 Anthro 419
Credit 3 units. A&S: NS A&S IQ: NSM Art: NSM

### L64 PNP 4192 Primate Cognition
This course investigates historical and current views regarding the cognitive capacities of nonhuman primates, and the extent to which these abilities are shared with humans. Topics for
L64 PNP 4210 Topics in Advanced Philosophy of Science
This course varies in topics related to philosophy of science from semester to semester. Prerequisites: one course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Same as L30 Phil 4210
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM

L64 PNP 426 Theories of Concepts
Concepts are the building blocks of thought. They are implicated in just about every cognitive task. Beyond that, there is little consensus. What information do concepts encode? How are they acquired? How are they combined to form thoughts? How are they related to perception and imagery? Each of these questions has been answered in numerous ways. In this course, we will explore competing theories of concepts that have been proposed by philosophers, psychologists, and other cognitive scientists. No prior acquaintance with these issues is required. Prerequisites: one previous course in Philosophy at the 300 level, graduate standing, or permission of the instructor.
Same as L30 Phil 426
Credit 3 units. A&S: TH A&S IQ: HUM Art: HUM

L64 PNP 4302 Cognitive Psychology Applied to Education
This course is intended to cover topics in the cognitive psychology of human memory, conceptual learning and comprehension with special focus on areas, theory and research that have potential application to education. Thus, the course provides selective coverage of theoretical and empirical work in cognitive psychology that provides potential to inform and improve educational practice. The applicability of these themes is explicitly developed and evaluated through the primary research literature using educationally oriented experimental paradigms. The course is of interest and benefit to education majors and to psychology majors interested in cognitive psychology and its applications. Prerequisites: junior/senior status, 9 units in psychology and Psych 100B or junior/senior status, 9 units in education and Psych 100B.
Same as L33 Psych 4302
Credit 3 units. A&S: SS A&S IQ: SSC EN: S

L64 PNP 4315 Culture, Language and the Education of Black Students
This course examines the communicative patterns of what is called variously African-American language, Pan-African linguistic systems and Ebonics within the context of public school policy and practice. In addition to a review of the structural and pragmatic aspects of black speech, the course highlights relationships between controversies within the linguistic community, contrasting views of speech within black lay communities, public discourse, and educational policy. Students also conduct a field-based research project in accord with their particular interests.
Same as L12 Educ 4315
Credit 3 units. A&S: SS, CD A&S IQ: LCD, SSC Art: SSC EN: S

L64 PNP 4332 Cognition and Computation
This course introduces students to some of the key frameworks for thinking about the mind in computational terms. We look at some basic topics in the theory of computation, in addition to considering philosophical issues raised by computational models of cognitive processes. This course is required for graduate students in the PNP PhD program. Prerequisites: at least two 400-level PNP courses cross-listed in Philosophy.
Credit 3 units. A&S: SS A&S IQ: SSC EN: S

L64 PNP 4450 Functional Neuroimaging Methods
This course is intended for students wishing to become sophisticated producers or consumers of functional neuroimaging data. Emphasis will be on extracting the most information from neuroimaging techniques toward the goal of answering psychologically motivated questions. A number of issues relating to neuroimaging methodology will be covered, including technical principles, acquisition options, potential sources of artifact, experimental design, software tools, and analytical techniques. Class approach will be hands-on, with students gaining experience in actually acquiring and working with neuroimaging data. Prerequisites: Permission of instructor required.
Same as L33 Psych 4450
Credit 3 units. A&S: SS A&S IQ: SSC Art: SSC EN: S

L64 PNP 4488 The Cognitive Neuroscience of Film
To understand complex events in real life depends on perception, action and memory. To understand movies, people probably depend on similar psychological and neural mechanisms. This seminar uses results from psychology and neuroscience to try to better understand the experience of a movie viewer, and uses theory and practice to explore psychological hypotheses about perception. Prerequisite: Psych 360 or Psych 3604, or Psych 4604, or graduate standing in psychology.
Same as L33 Psych 488
Credit 3 units. A&S: NS A&S IQ: NSM

L64 PNP 4466 Second Language Acquisition
There are many ways in which a second language can be learned: from infancy as the child of bilingual parents, or later through formal instruction, immersion in a new culture, or in a particular work or social situation. This class is an inquiry into the processes by which acquisition occurs. Topics include the nature of language learning within the scope of other types of human learning; the relationship between first- and second-language acquisition; the role of linguistic, cognitive and sociocultural factors; insights gained from analyzing learners' errors; key concepts such as interlanguage and communicative competence; bilingualism; the optimal age for second-language acquisition; and a critical appraisal of different theories of second-language acquisition. Both theoretical and instructional implications of second-language acquisition research are considered. This course can be used toward certification in TESOL and is a required course for the Graduate Certificate in Language Instruction. Prerequisite: Ling 170D or equivalent is recommended, especially for undergraduates, but is not required.
Same as L44 Ling 466
Credit 3 units. A&S: LA A&S IQ: HUM EN: H
L64 PNP 467 Grammar and Vocabulary Acquisition
This course examines theoretical and instructional implications of research on grammar and vocabulary acquisition. Topics include making form-meaning connections during language learning; developmental stages; the role of input and input processing; explicit and implicit methods of grammar instruction; pertinent factors in vocabulary acquisition, such as a learning context and processing resource allocation; and comparisons of incidental and direct vocabulary instruction techniques. Major theories of language acquisition (e.g., nativism, emergentism) are critically examined in light of the research presented, and research findings are applied to instructional practices.
Same as L38 Span 467
Credit 3 units. A&S: LA A&S IQ: LCD BU: BA EN: H

L64 PNP 4691 Second Language Reading and Writing: Theory, Research and Practice
This course, taught in English, extends issues in second language literacy beyond pedagogy by examining the wide range of theoretical and research issues, both historical and current. Literacy acquisition among second language learners involves a number of variables including both cognitive and social factors. Topics discussed in class include literacy and social power, universal cognitive operations, individual learner differences, text types and literary forms, and the extent to which reading and writing are interrelated. Students discuss how to bridge research and practice, and they create reading and writing activities driven by theory and empirical investigations. This course is a required course for the undergraduate minor in applied linguistics and an elective for the Graduate Certificate in Language Instruction.
Same as L38 Span 4691
Credit 3 units. A&S: SS A&S IQ: SSC EN: S

L64 PNP 495 PNP Seminar
Subject varies per semester. Not always offered as writing-intensive, refer to individual semester listing. Prerequisites: a 300-level philosophy course (Phil/PNP 315 is recommended) and PNP major standing or approval of instructor.
Credit 3 units. A&S: SS A&S IQ: SSC EN: S

L64 PNP 495W PNP Seminar: Writing Intensive
Subject varies per semester. Fulfills Writing Intensive (WI) requirement. Prerequisites: a 300-level philosophy course (Phil/PNP 315 is recommended); and PNP major standing or approval of instructor.
Credit 3 units. A&S: SS, WI A&S IQ: SSC, WI EN: S

L64 PNP 496 PNP Seminar
Subject varies each semester. Prerequisites: a 300-level philosophy course (Phil/PNP 315 is recommended); and PNP major standing or approval of instructor.
Credit 3 units. A&S: SS A&S IQ: SSC EN: S

L64 PNP 499 Study for Honors
Prerequisites: Visit http://pnp.artsci.wustl.edu/undergraduate/honors/prerequisites.
Credit 3 units. A&S: SS EN: S