This year’s theme is how experience shapes our brain and cognition. This course is designed to provide a cohesive and interactive experience for senior and junior Neuroscience and Behavior Majors, through 3 major types of educational experiences: 1) reading the scientific literature and discussing it, 2) writing short scientific commentaries and learning to edit and revise through student-led writing workshops, and 3) teaching neuroscience in local high schools through service learning projects. Lectures and classroom discussions are a central feature of this course. Students are expected to complete the readings before coming to class and to participate in classroom discussions. Writing Component. Students probe the scientific literature in four interrelated units and write a blog and three commentaries on the topics. The written work will be shared on Moodle and during class meetings in designated writing workshops. Combining feedback from the instructor and writing tutor with input from peers, students edit and polish their science writing. Selected written pieces will be submitted to Synthesis, the Wesleyan University student-run scientific journal featuring art and science. Guest Lectures. The invited speakers will provide insights into research in the fields of neuroscience that touch upon the topic of experience and the brain. Service Learning Component. The service-learning aspect of the course involves preparing and giving a class on one of the topics in the course to high school students. Students learn how to conduct themselves as teachers and reflect on their experiences. Invited guests including Allison Gamber from the Epilepsy Foundation and Cathy Lechowicz from Wesleyan University’s Civic Engagement and Service Learning program will lead discussion about how to explain neuroscience concepts to the lay-public and high school students.

Unit 1: Visualizing The Brain From Genome To Synaptome To Connectome. How will neuroinformatics, software, neuroimaging, and interactive databases contribute to a better understanding of the human nervous system and cognition? Will these databases be useful for representing how experience shapes the nervous system and behavior? Students learn to use software tools to research the patterns of gene expression in the human and other mammalian brains using Brain Navigator (Elsevier), the Allen Brain atlas and other computer-based navigation systems to analyze protein, gene, and structural similarities and differences in the brain.

Unit 1.1 Carl Schoonover, Portraits of the Mind: Visualizing the Brain from Antiquity to the 21st Century (Abrams, November 2010). Columbia graduate student Carl Schoonover’s book describes the fascinating history of brain exploration through text and vibrant images that resemble abstract art, but are in fact, derived from scientific publications in the field of neuroscience. The lecture will range from a discussion of medieval sketches and 19th-century drawings by Ramon y Cajal to images produced using state-of-the-art techniques such as Brainbow and DTI. http://www.carlschoonover.com/. The learning objectives for this unit are for students to gain an appreciation for ways of presenting scientific information about the brain and the inherent beauty of scientific imagery of the brain.

Unit 1.2 Allen Brain Atlas and Brain Navigator. We explore the powerful software and on-line databases – BrainNavigator and the Allen Brain Atlas (http://human.brain-map.org/ and http://www.brain-map.org/). Just as we use a Global Positioning System (GPS) to navigate
in geographical space, BrainNavigator is a workflow tool that allows us to navigate in 3-D through brain structures in adult and developing brains. This information can be combined with gene expression data in 2D and 3D, and related literature can be rapidly located. After gaining familiarity with these new tools, we’ll brainstorm about the future of brain maps. The learning objective for this unit is for students to have hands-on experience with software tools for visualizing patterns of gene and protein expression in the brain in 3-D space.

Unit 1.3 The Connectome and Connectomics. The goal of the Connectome Project is to generate an interactive database with the complete set of neural connections in the human brain (by analogy to the Human Genome Project). The field that describes how these connections are assembled, mapped and analyzed is called connectomics. This field is based on the premise that the physical connections in the brain are intricately linked to brain function and cognition, through multiple levels and modes. The Connectome places strong constraints on which neurons or neural populations can interact, based on synaptic strength and propinquity of interactions. We’ll discuss some of the new technologies that will allow analysis of large-scale connectivity of the nervous system including: Brainbow and other transgenic tools, Chloemeleon, Optogenetics, Diffusion Tensor Imaging (DTI), and different labs contributing to the Connectome project (http://www.humanconnectomeproject.org/) and Ted Talk by Sebastian Seung http://www.youtube.com/watch?v=HA7GwKXfJB0. The objective of this unit is for students to become familiar with the Connectome and Synaptome and some of the breakthroughs in technology that make it feasible to compile a massive database containing the functional architecture of the entire human nervous system.

Unit 2: How do neural activity and experience regulate neural circuitry? It is known that neural activity shapes synaptic connections in our nervous system during development and after damage, but how does this occur? The learning objective for this unit will be for students to gain a mechanistic understanding of the role of sensory experience during critical periods of development and how experiences guide the development of neural circuits and function. Readings highlight neuroscience research on the topic of neuroplasticity, as revealed by sensory deprivation and other manipulations that change patterned neural activity during brain development. We will also examine the circuits for emotion, in particular fear, and how experiences and learning contribute to our perception of danger and other emotional stimuli. We will learn about genetic mutations that cause autism or savant syndromes and the altered processing of emotions or enhanced abilities in some domains but reduced abilities in others that result from combined genetic and experiential factors.

Unit 2.1 Activity-dependent synaptic plasticity. Readings in this class focus first on the role of the GABAergic system in regulating the critical period for ocular dominance plasticity and secondly on the role of patterned neural activity for regulating the formation of visual maps. Guest speaker Michael Crair (Yale University will discuss research from his laboratory that investigates the role that patterned neural activity in the visual system plays in forming maps and pathways.

Unit 2.2 Emotion: Genes and Environment. Joseph LeDoux’s book The Emotional Brain, discusses the central role of the amygdala in fear and emotional responses. Readings will highlight the Darwinian view that there is an evolutionarily conserved neural circuit for the emotion of fear.
**Unit 2.3 Altered processing of emotion in individuals with autism.** Many studies highlight the role of genes and the environment in regulating cognition. Disruption of proper synaptic development may be the underlying defect in neurodevelopmental disorders, including autism. Readings include Michael Hadden’s, *The Curious Incident of the Dog in the Night-Time*, which chronicles the thought process of a young boy with autism spectrum disorder and how perceptions of the emotional states of others are disrupted in autism. Guest speaker, Kari Weil (Wesleyan University) will lead a discussion of Rilke’s poem *Duino Elegies*, about the nature of consciousness in humans and animals. In the subsequent class with Professor Weil, we’ll discuss Descartes’ extreme view that animals are machines without emotions and we’ll explore what it means to be human (as opposed to an animal). Readings will be from the works of Temple Grandin, a high-functioning autistic individual, received intensive training as a child to help her develop language and social skills. She is an important autism advocate who helps raise awareness and understanding about the experience of autistic individuals. Grandin was on *TIME* magazine’s list of 100 people who most affect our world, and the recent movie about her life, *Temple Grandin* starring Claire Danes, has received much acclaim. In addition to her work as an autism advocate, Grandin is an accomplished doctor of Animal Science and a consultant on animal welfare issues who has worked to improve standards in slaughterhouses and livestock. Her ability to notice detail and understand the experience of cattle and other animals helps her to "see" the issues with the way livestock are treated and handled. Through the writings of Oliver Sacks and others, we’ll learn about savant syndromes (including William’s syndrome, a neurodevelopmental disorders) and the extraordinary abilities and disabilities of these individuals. Lastly, we will learn about another neurodevelopmental disorder associated with autism and severe learning disabilities, Fragile X syndrome. Guest lecturer Susan Goebel Goody will speak about her research on animal models of Fragile X and the role of the environment and synaptic activity in this disorder.

**Unit 3: Epilepsy and the Plastic Mind**

In this unit, students learn about the role of abnormal neural activity in epilepsy and its effect on the brain. The learning objective for this unit is for students to gain a mechanistic understanding of some of the environmental and genetic factors that cause neuronal hyperexcitability in epilepsy and the new therapies on the horizon for treating this disorder. We’ll talk about some of the newer treatments for epilepsy that are on the horizon, including gene therapy, stem cell therapy, and deep brain stimulation. Our guest speaker is Allison Gamber, Program Coordinator for The Epilepsy Foundation of Connecticut in Middletown (http://www.epilepsyct.com/). Allison will discuss how to teach middle and high school students about epilepsy and provide teaching materials from the Epilepsy Foundation. Stem cell biologist and neuroscientist Ashok Shetty will give a guest lecture about stem cell-based therapies for temporal lobe epilepsy.

**Unit 4: How do exercise and environmental enrichment influence brain structure, memory and cognition?** In this unit, students learn about the effect of physical exercise on the brain. The learning objective for this unit is for students to gain a better understanding of the physical changes in the brain brought about by exercise and how these changes alter cognition and behavior. We learn about how exercise induces changes in adult neurogenesis, growth factors, and regional blood flow in the brain. Recent studies showing that exercise can alter or slow the progress of several neurodegenerative disorders will highlight the importance of physical exercise in maintenance of synaptic function and cognition.
Unit 5: Civic Engagement and Service Learning. In this part of the course, students will develop classroom presentations that teach neuroscience concepts at the high school level. Students will prepare a learning module on one of the topics from the course, present their module to our class and then take it on the road to a local high school. Students will videotape and podcast of their presentations, and write self-reflections on their experiences. These projects will take place in late April and early May. The learning objective for this unit is for students to consolidate what they have learned in the course by teaching neuroscience to high school students. Students will gain an appreciation for the difficulty of explaining scientific concepts clearly and motivate high school students to learn more about neuroscience.

Grading: Blog, 10 points; Commentary 1, 15 points; Commentary 2, 20 points; Commentary 3, 20 points; service learning teaching module, outreach presentation in local high school, and self-reflection essay, 25 points; class attendance and participation, 10 points.

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Writing Tutor: Cameron Couch  
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Cell: 860 817-2397

Students with Disabilities:  
It is the policy of Wesleyan University to provide reasonable accommodations to students with documented disabilities. Students, however, are responsible for registering with Disabilities Services, in addition to making requests known to me in a timely manner. If you require accommodations in this class, please make an appointment with me as soon as possible (during the 3rd week of the semester) so that appropriate arrangements can be made. The procedures for registering with Disabilities Services can be found at:  
http://www.wesleyan.edu/studentaffairs/disabilities
<table>
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<tr>
<th>Week/Class</th>
<th>Date</th>
<th>Topic</th>
<th>Suggested Readings (due on the date listed)</th>
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<tr>
<td>1/1</td>
<td>01/26/12</td>
<td>Course overview</td>
<td>1. LeDoux (2002) Ch. 3 &amp; 4 <em>Synaptic Self</em></td>
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| 2/2        | 01/31/12 | Unit 1.1 - Visualizing the brain from Antiquity to the 21st Century | 1. Schoonover, *Portraits of the Mind* (on reserve Sci Library and in bookstore)  
*Short Response Paper* (1 page, typed, upload onto Moodle) |
| 2/3        | 02/02/12 | Unit 1: Writing workshop #1 (response essay)              | 1. Zinsser; Ch. 5, 10 & 15  
2. UNC Passive Voice handout  
3.                                                      | Revision Assign. #1                                                                                   |
| 3/4        | 02/07/12 | Unit 1.2 – Allen Brain Atlas and Brain Navigator          | 1. BrainNavigator software  
*List and Cube: Brain Navigation software and the Connectome* |
| 3/5        | 02/09/12 | Unit 1.3 – The Connectome Project                         | 1. Connectome (http://www.humanconnectomeproject.org/).  
3. Insel (2010) *Faulty Circuits, Scientific American*  
6. Livet et al. (2007)                                                      | Writing Assign. #3:  
*Blog: Brain Navigation and the Connectome* |
| 4/6        | 02/14/12 | Unit 1: Writing workshop #2 (Blog)                        |                                                                                                          | Blog Revision  
Read classmates blogs                                                                 |
| 4/7        | 02/16/12 | Unit 2.1: Experience-dependent plasticity: GABA          | 1. Hensch et al 1998  
2. Southwell, 2010  
3. Lee et al 2006  
4. Gonchar and Burkhalter (2007)                                                      | Writing Assign. #4:  
*List and Cube – GABA and critical periods for ocular dominance plasticity* |
| 5/8        | 02/21/12 | Michael Crair, Yale Guest Lecturer: Neuroplasticity      | 1. Zhang et al. (2011) *Binocular activity and visual map formation. Nat Neurosci*  
*Commentary (1): Crair articles or Hensch articles* |
<p>| 5/9        | 02/23/12 | Unit 2.2: Emotion circuits                               | 1. LeDoux; Ch. 5 <em>The Way We Were, In: Emotional Brain</em>                                                  | 1-page of discussion questions       |</p>
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2. Rilke, The Eighth Elegy (poem) *Duino Elegies* | 1-page of discussion questions |
| 6/11 | 03/01/12 | Autism and the question of consciousness; Kari Weil Guest | 1. Grandin 1995) Ch. 1-3 *Thinking in Pictures*  
3. Descartes (1596-1650) *Animals are Machines.* | 1-page of discussion questions |
| 7/12 | 03/06/12 | Prodigies and Savant Syndromes | 1. Sacks, *Musicophilia* (2007) Ch.28  
2. Tammet (2009) *Think Better: Tips from a Savant* *Sci Am Mind*  
4. Young EJ (2008) Reduced fear…  
| 7/13 | 03/08/12 | Fragile X syndrome; Susan Goebel-Goody Guest Lecturer | 1. Goebel-Goody and Lombroso (2012) Ch. 12 Taking STEPS Forward…  
2. Restivo et al. (2005) Enriched environment…  
3. Dolen and Bear (2009) Fragile X syndrome  

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<th>Date</th>
<th>Notes</th>
<th>Unit 2: Writing Workshop #3</th>
<th>1. Brady, L Responding to student writing <a href="http://www.as.wvu.edu/~lbrady/response.html">http://www.as.wvu.edu/~lbrady/response.html</a></th>
<th>Revisions: Blog and Commentaries #1 &amp; 2; discuss plans for Synthesis</th>
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<tr>
<td>10/14</td>
<td>03/27/12</td>
<td>Unit 3: Epilepsy; Allison Gambrer Guest Lecturer</td>
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<td>10/15</td>
<td>03/29/12</td>
<td>Epilepsy Foundation Materials</td>
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<td>1 page of discussion questions</td>
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| 11/16 | 04/03/12 | Embryonic stem cell-based therapy for epilepsy | 1. Naegele et al. (2010) Recent Advancements…*Neuropharm*  
<p>| 11/17 | 04/05/12 | Ashok Shetty Guest Lecturer; Fetal Stem Cell Therapy for Epilepsy | 1. Shetty (2011) Progress in Cell Grafting… <em>Neurotherapeutics.</em> | 1 page of discussion questions |</p>
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<th>Reading(s)</th>
<th>Writing(s)</th>
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<tr>
<td>11/17</td>
<td>Ashok Shetty Guest Lecturer; Fetal Stem Cell Therapy for Epilepsy</td>
<td>1. Shetty (2011) Progress in Cell Grafting…. <em>Neurotherapeutics.</em></td>
<td>1 page of discussion questions</td>
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<td>2. Waldeau et al (2010) <em>Stem Cells</em></td>
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<td>2. Erickson et al (2011) <em>PNAS</em></td>
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<td>3. Rhyu et al. (2010)</td>
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<td>12/19</td>
<td>Exercise and Brain function in neurological diseases</td>
<td>1. Pothakos et al. (2009)</td>
<td>Writing Assign. #9” <em>Commentary (3): Exercise and Cognition</em></td>
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<td>2. Wood et al. (2011)</td>
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<td>13/20</td>
<td>Unit 5: Civic engagement and Service Learning (35 minutes)</td>
<td>1. Ash and Clayton (2009) Generating, deepening and augmenting learning….</td>
<td>Further revisions of writing; put together writing portfolio; discuss plans for</td>
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<td>Writing Workshop # 4 (45 minutes)</td>
<td><em>J. Applied Learning in Higher Education</em></td>
<td><em>Synthesis</em></td>
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<td>2. Fried RL Designing a unit. In: <em>The Passionate Teacher</em></td>
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<td>13/21</td>
<td>Service learning</td>
<td>Break out groups – planning for classroom presentations</td>
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<td>Service Learning</td>
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<td>Learning objectives and PowerPoint</td>
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