Functional Anatomy of the Human Brain

Course Syllabus

Course description

The focus of this course is the structure of the human brain and spinal cord, and the functional organization of the central nervous system. This course will entail extensive, hand-on examination of human brain specimens as the primary means for instruction and learning. This experience will be supplemented by use of interactive digital atlases to learn the gross anatomy of the central nervous system and the organization of the major neural systems underlying sensory, motor and cognitive function. In addition, brain models and histological sections of the human brain will be examined. Readings from Blumenfeld (2010) will provide reference for learning the functional anatomy of the human nervous system. Consideration and analysis of actual clinical cases representing a variety of neurological disorders will provide the means for consolidating understanding of functional neuroanatomy. In-class experiences will be organized around the principles of team-based learning, with students organized in small teams for Readiness Assessments, Team Applications and discovery in laboratory experiences. Minimum prerequisites: NEUROSCI 101 (101) or NEUROSCI 201 (114) and consent of instructor.

Course instructors

COURSE DIRECTOR

Leonard E. White, Ph.D.
Associate Professor
Duke University School of Medicine
Director of Education
Duke Institute for Brain Sciences
[click here for professional profile]

Primary academic appointment: Department of Community & Family Medicine, Doctor of Physical Therapy Division,
Duke University School of Medicine
Secondary academic appointment:  Department of Neurobiology  
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Institute affiliation:  Duke Institute for Brain Sciences  
Center affiliations:  Center for the Study of Aging and Human Development  
Center for Cognitive Neuroscience  
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Phone:  613-5028  
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office hours please check course website or e-mail to request an appointment

ASSISTANT INSTRUCTOR

Ariel B. Starr
PhD candidate in Psychology  
Dissertation mentor: Elizabeth M. Brannon (Psychology and Neuroscience)  
[click here for professional profile]  
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Course objectives

At the completion of this course the student will:

1. Demonstrate the major embryological subdivision of the central nervous system as seen on the surface of the human forebrain, hindbrain and spinal cord.
2. Describe the four lobes of the cerebral hemispheres and the neuroanatomical landmarks that define their boundaries in the human brain.
3. Identify major gyral and sulcal formations of the human cerebral cortex.
4. Sketch the lateral and medial views of the cerebral hemispheres of the human brain, with all major gyri and sulci identified.
5. Discuss the major functions that are localized in a clinically significant fashion to each of the four lobes of the cerebral hemispheres of the human brain.
6. Trace out the major vessels that supply the anterior and posterior arterial circulation to the forebrain, hindbrain and spinal cord, including the means by which venous blood and cerebrospinal fluid is drained out of the brain.

7. Identify internal components of the central nervous system in cross-sectional preparations and histological presentations, including ventricular spaces, major white matter structures and deep gray matter structures.

8. Sketch the organization of deep gray matter in the human forebrain relative to the ventricular system and major white matter structures.

9. Describe the organization of the major ascending and descending tracts of the brain and spinal cord, including neural systems for pain and temperature sensation, touch and pressure sensation, motor control, and vision.

10. Describe the location and function of the major neuroanatomical structures involved in motor and sensory processing.

11. Discuss the functional impairments associated with injury or disease affected major sensory and motor structures in the forebrain, hindbrain and spinal cord.

12. Discuss the functional impairments associated with injury or disease affected major cognitive systems in the forebrain and hindbrain.

13. Display competency in discussing basic and applied research in neuroscience.

**Learning resources**

We will mobilize and employ a variety of instructional resources for this course, including:

**Sakai website** for NEUROSCI 380L [check frequently—daily—for announcements]


- cost: $72.21 (hardcopy)
  - $38.23 (e-book subscription)

**supplemental reader:** activities and excerpts from White LE and Cant NB (2010) *A Laboratory Guide for Learning Functional Human Neuroanatomy.* (self-published)

- cost: PDF distributed gratis to enrolled users (print at your own cost)

cost: $40.76 (stand-alone media)

$96.01 (bundled with reference textbook and primary textbook for NEUROSCI 201 (114); see below)

$96.01 (bundled with primary textbook for NEUROSCI 112: Purves et al. (2008) *Principles of Cognitive Neuroscience.*)


cost: free via www [click here]


cost: $96.01 (bundled with *Sylvius4*)

**Instructional methods**

We will employ a variety of instructional methods to enhance your learning experiences in this course. Traditional teaching methods will include in-class tutorials and active laboratories. Additional methods will include the principles and practices of *team-based learning*, including individual and group Readiness Assessments (iRAs and gRAs, respectively) and Team Applications, during which you will problem-solve and help guide the learning of members of your team as well as other classmates. In addition, online tutorials and online guides to reading assignments will provide structure for individual and team learning in advance of each of class session. The course website (Sakai) will also serve as a means for building a community of learning and discovery in the course, with extensive use of communication tools, including Group Pages, Discussion Boards, and—if needed—online chat sessions with the course instructors.
Course policies

Requirements. Each learner and instructor is expected to uphold the Duke Community Standard in all academic and non-academic endeavors associated with this course.

_Duke University is a community dedicated to scholarship, leadership, and service and to the principles of honesty, fairness, respect, and accountability. Citizens of this community commit to reflect upon and uphold these principles in all academic and non-academic endeavors, and to protect and promote a culture of integrity._

_To uphold the Duke Community Standard:_

- I will not lie, cheat, or steal in my academic endeavors;
- I will conduct myself honorably in all my endeavors; and
- I will act if the Standard is compromised.

This Standard emphasizes dedication to scholarship, leadership, and service, and to the principles of honesty, fairness, respect, and accountability—all values that we will uphold in our studies of the Functional Anatomy of the Human Brain.

Readiness assessments. Each learner will come to class having prepared for the day’s session activities, be they tutorials, laboratory experiences, team discussions or team applications. Readiness Assessments (RA) are designed to encourage you to meet this expectation. RAs will sample your knowledge of core, foundational content which, through required readings, on-line handouts, and other educational materials, you will be expected to study outside of the classroom. You should expect a Readiness Assessment at the outset of each course session (after the first course session) through the first half of the course (see Course calendar section of the syllabus for details on the schedule of RAs). You will take these assessments first on an individual basis (called an individual Readiness Assessment; iRA), and then again as a team (called a group Readiness Assessment; gRA). Thus, following the iRA, you will have the opportunity in “real time” to improve your knowledge and understanding of the foundational material that will set the stage for the applied learning that follows. You will also have the opportunity to improve your overall performance on the session’s RA by working with other members of your team on the gRA. iRAs/gRAs will typically comprise 10-15, multiple-choice questions. As the semester progresses, the number of questions will increase slightly as questions from previous iRAs/gRAs will be incorporated to assess your retention of cumulative course material. Each RA session will last, on average, about 50 minutes. This will include facilitated discussion among teams as well as clarifying input from your course instructors. During each RA session, all questions in both phases of the RA (iRA/gRA) are to be complete without the aid of any external sources (i.e., closed book and closed internet). As a significant percentage of your score on each assessment will be determined by your team’s performance, you have a strong incentive to work together effectively as a team both in and out of the classroom setting.

Team Applications. Team Applications (TA) are structured around clinical cases from the neurology practice of Dr. Hal Blumenfeld (MD, PhD), as presented in Blumenfeld (2010), or cases from the practice of neurologists at Duke Hospital—most notably from the practice of Dr. Talmage L. Peele (MD). TA sessions require mobilization and application of foundational content from previous weeks of study in
the course, but no specific preparation by you ahead of time (other than review and study of cumulative course content). During TA sessions, you will work in your teams to synthesize a concept or series of concepts or to address the neuroanatomical bases for a specific set of presenting clinical signs and symptoms.

**Peer Assessments.** To succeed in your learning throughout *Functional Neuroanatomy* it will be essential to function well in teams. This requires personal accountability and a desire to receive constructive feedback from your teammates. To promote optimal teamwork, team members will regularly assess one another’s contributions to the functioning of the team. This will be done after course meetings in weeks 4, 8 & 12. Each team member will complete a brief survey form that will assess *Cooperative Learning Skills, Self-Directed Learning* and *Interpersonal Skills*. The process will begin with a self-assessment before each round of peer assessment; the self-assessment would then become part of data used by the peer assessor, giving the peer assessor opportunity to comment on each teammate’s self-assessment. Each student will then receive a summative report of their team’s peer assessment, with individual comments anonymized. This procedure is designed to encourage reflection, introspection and evaluation. It is also designed to provide a means for the routine assessment of your peers to factor into your overall performance metric for the learning event (in a phrase, *teamwork matters*!). Each peer assessment will yield a peer score and the average of the three peer assessment scores will be calculated and used as a weighting factor to apply teamwork scores to each individual. *Individual contributions to team success can and should be governed by team members.* By providing regular opportunities for peer assessment, potential challenges to team effectiveness can be quickly identified, and appropriate strategies for improvement can be implemented.

**Team membership.** To construct highly functional teams of learners for team-based learning activities, students will complete a short survey to gather relevant data, and then students will be assigned to teams of 4-5 learners each by the instructor. Please note, once team assignments have been made, *there is no option for changing teams.* Teams will function according to the “form → storm → norm → perform” model, meaning that some friction among teammates is to be expected as part of the process required for normalizing the contributions of all team members and achieving a high level of team performance. Problems within teams should be dealt with within the team; the course instructor may facilitate resolution of conflict within a team, but only after teams have exhausted their capacity to do so on their own.

**Attendance.** As this course meets only once per week, attendance of all course sessions is encouraged in the strongest terms. However, illness, family emergencies, medical or graduate school admissions interviews, and other legitimate life-events occur that require your presence elsewhere. When such events do occur, you must inform the course instructor in advance of the learning event. Excused absences from Readiness Assessments will be made-up by completion of the individual Readiness Assessment via a time and mechanism to be determined by the course instructor. It is simply not possible to recreate group learning activities (group Readiness Assessments, Team Applications, laboratory experiences, etc.) when an absence occurs. Therefore, absences will result in no points earned by the absentee for the group components of those learning events.
**Grading.** The assessment strategies for this course will be weighted as follows:

<table>
<thead>
<tr>
<th></th>
<th>Individual Assessment</th>
<th>Group Assessment*</th>
<th>Percentage of Final Grade</th>
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<tbody>
<tr>
<td>Readiness Assessments</td>
<td>60%</td>
<td>40%</td>
<td>60</td>
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<tr>
<td>Team Applications</td>
<td>100%</td>
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<td>40</td>
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* All scores for group assessments will be applied to the individual student with a weighting factor derived from the peer assessment process (see above section on Peer Assessment).

The distribution of weight between iRA and gRA assures that 50% of the final grade for the course is achieved on the basis of individual work (iRA), and 50% is based on team work (gRA and Team Applications). Note: **there are no exams in NEUROSCI 380L.** All assessment points are earned on a weekly basis in each class session’s team-based learning activities.

**Course calendar**

**Topic outline.** The following table provides a session-by-session listing of topics to be covered in NEUROSCI 380L, as well as assigned readings for preparation in advance of the course session. The textbook for this course features numerous outstanding figures and charts that depicts various aspects of human neuroanatomy. The table on the following pages includes a column titled, **Featured Figures,** which will assist the learner in her/his preparations for each Readiness Assessment. Consider the figures listed in this column as those that should be the principal focus of study and learning in advance of class. The topic list in the table provides the weekly structure for the learning sequence; however, changes may be made by the course instructor as the course progresses to facilitate achievement of course objectives. All classes meet on **Mondays,** from **4:40-7:10 PM,** in **Rooms 3002 and 3006** of **GSRB II** (Research Drive).

<table>
<thead>
<tr>
<th>WEEK</th>
<th>TOPIC</th>
<th>TBL EVENT</th>
<th>ASIGNED READINGS</th>
<th>FEATURED DISPLAYS</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Course overview &amp; introduction to team-based learning</strong></td>
<td>practice iRA/gRA</td>
<td>course syllabus Lab Challenge: <em>Considering the Central Sulcus</em></td>
<td>Challenge Figures 1 &amp; 2</td>
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<td></td>
<td></td>
<td></td>
<td>Blumenfeld Chapter 2, pp. 14-17, 21-22, 24-31, 41-44</td>
<td>Figures 2.2, 2.4, 2.5, 2.10-2.13, 2.24, 2.25</td>
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<td>2</td>
<td><strong>Surface anatomy of the forebrain</strong></td>
<td>iRA/gRA</td>
<td>Blumenfeld Chapter 5, pp. 126-137; Chapter 16, pp. 740-748; Chapter 18, pp. 820-826, 829-833</td>
<td>Figures 5.1, 5.5, 5.10-12, 16.1-4, 18.4, 18.7, 18.10</td>
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<tr>
<td>3</td>
<td><strong>Sectional anatomy of the forebrain</strong></td>
<td>iRA/gRA</td>
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<tr>
<td>WEEK</td>
<td>TOPIC</td>
<td>TBL EVENT</td>
<td>ASSIGNED READINGS</td>
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<td>4 [Sept. 17]</td>
<td>Cerebral hemispheres and vascular supply</td>
<td>iRA/gRA</td>
<td>Blumenfeld Chapter 2, pp. 44-46; Chapter 5, pp. 137-139; Chapter 6, pp. 229-230; Chapter 10, pp. 392-409; Chapter 14, pp. 648-653</td>
<td>Figures 2.26, 5.1, 5.8, 5.9, 6.5, 10.2-10.9, 10.11, Table 10.1, 14.18, 14.19</td>
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<tr>
<td>5 [Sept. 24]</td>
<td>Surface anatomy of the brainstem and spinal cord</td>
<td>iRA/gRA</td>
<td>Blumenfeld Chapter 2, pp. 21-24; Chapter 8, pp. 320-322; Chapter 12, pp. 494-498, 500-525, 530-535</td>
<td>Figures 2.8, 2.9, 2.22, 8.1, 12.2, 12.6, 12.7, 12.10, 12.20, 12.21; Tables 12.1, 12.4</td>
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<tr>
<td>7 [Oct. 8]</td>
<td>Corticospinal tract and other motor pathways</td>
<td>iRA/gRA</td>
<td>Blumenfeld Chapter 6, pp. 223-249</td>
<td>Figures 6.1, 6.6-6.11, 6.14; Tables 6.3, 6.4</td>
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<td>8 [Oct. 15]</td>
<td>no class meeting—Fall Break &amp; Annual Meeting of the Society for Neuroscience (New Orleans LA)</td>
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<td>9 [Oct. 22]</td>
<td>Somatic sensory system</td>
<td>iRA/gRA Team Application</td>
<td>Blumenfeld Chapter 7, pp. 275-297</td>
<td>Figures 7.1-7.10, Table 7.1</td>
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<td>11 [Nov. 5]</td>
<td>Cerebellum</td>
<td>iRA/gRA Team Application</td>
<td>Blumenfeld Chapter 15, pp. 697-711</td>
<td>Figures 15.1-15.5, 15.9, 15.11</td>
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<td>12 [Nov. 12]</td>
<td>Basal ganglia</td>
<td>iRA/gRA Team Application</td>
<td>Blumenfeld Chapter 16, pp. 739-762</td>
<td>Figures 16.1-16.9, Table 16.2</td>
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<tr>
<td>13 [Nov. 19]</td>
<td>Hypothalamus: homeostasis/allostasis</td>
<td>iRA/gRA Team Application</td>
<td>Blumenfeld Chapter 17, pp. 791-800</td>
<td>Figures 17.1-17.5</td>
</tr>
<tr>
<td>14 [Nov. 26]</td>
<td>Limbic system: memory and emotion</td>
<td>iRA/gRA Team Application</td>
<td>Blumenfeld Chapter 18, pp. 819-858</td>
<td>Figures 18.1-18.2, 18.4-18.9, 18.11, 18.13, 18.15, 18.17</td>
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<tr>
<td>16</td>
<td>no final exam</td>
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