

PY299: NEUROSCIENCE

Blocks 1-2, 2008: Lori Driscoll, Bob Jacobs

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Course Description

No, nor nowhere else but in your brain.

(Shakespeare, *The Merry Wives of Windsor*, IV, ii, 139)

Shakespeare was right--there is, in a sense, nothing that exists outside your brain. Almost all areas of psychology require at least a working knowledge of the brain. It is indeed doubtful if one can truly understand behavior without knowledge of the neural substrate that makes all behavior possible. Psychology 299: Neuroscience provides you with an opportunity to learn about the basic structure and function of the human brain. The term *neuroscience* refers to investigations of the development, organization, and functioning of the nervous system.

In order to provide you a guided tour of the brain, the course follows primarily a lecture format with an extensive laboratory component designed to give you "hands on" experience with human tissue. Emphasis is placed on fundamental neurobiological principles, including an overview of the relevant neurophysiology, neuropharmacology, and especially neuroanatomy (e.g., embryology and histology, sensory processing from the spinal cord/brain stem to thalamo-cortical systems, the cerebral hemispheres, the limbic system, etc.). For most of you, this will be the only course where you can obtain a good foundation in neural structure, and therefore the course is organized neuroanatomically.

Although the course does not assume any specialized scientific knowledge, it remains a challenging course, requiring the same commitment as would any study of a foreign language. Indeed, learning neurobiology means that you must learn the "language of the brain"; there is no getting around this. [see: <http://faculty.washington.edu/chudler/neuroroot.html>] Without a core knowledge of the neural substrate, any subsequent discussion of function quickly loses contact with reality. As noted recently by Damasio (1994):

. . . neuroanatomy is the fundamental discipline in neuroscience. . . There can be no hope of understanding the many levels of brain function if we do not have a detailed knowledge of brain geography at multiple scales (p. 25).

The course should not be viewed as an end to itself, but rather as a window to a new perspective. The knowledge obtained in the course should both guide and constrain future thinking about issues related to the human brain and mind, be they in the linguistic, philosophical, psychological, social, or political domain. The course provides the tools with which you can continue your exploration of psychology, biology, and/or neuroscience. In fact, the knowledge of the brain you gain in this course will profoundly affect your perception and appreciation of everything you do.

The main goal of the course is that you obtain an ACTIVE (rather than passive) knowledge of the brain. To this end, you will be asked to participate in the Elementary School Outreach Program, a program designed for you to share your newly acquired knowledge of the brain with elementary school children.

Lectures will generally begin exactly at 8:45 AM you will be expected to be available until 3 PM most days for review and any extra sessions not on the syllabus. Cell phones etc. must be turned off during lectures.

How is this course relevant to Psychology? This course, or its equivalent (e.g., biological psychology, physiological psychology) is required for psychology majors at almost every university/college. This is done for a reason. Along with Research Design, it forms the core of psychological investigations into behavior—all behavior (indeed, everything one studies in the humanities) derives from brain function at some level. CC students who have already taken Psychology courses beyond Research Design have often noted how knowledge of the brain has enriched their understanding of the material covered in these courses. However, if you have not taken many Psychology courses yet, here are but a few examples of direct links between this class and other Psychology courses:

- **Clinical/abnormal psychology.** This is probably the area of psychology for which Neuroscience is *most* relevant! As a clinician, your job is to treat humans. But what in those humans produces the abnormal or maladaptive behavior in the first place? The brain. What do clinicians treat? Whether they are using psychotherapy or drugs or both, they are ultimately attempting to alter maladaptive brain processes. Research shows that psychotherapy produces lasting effects on the brain, and that the magnitude of those brain changes correlate with the patient's self-reported level of improvement. ALL licensed clinicians are required to know something about brain systems and how they are affected by the therapies that they practice. If you plan to study clinical or abnormal psychology, the neuroscience course will give you a substantial head start.
- **Developmental and educational psychology.** Psychological development and neurobiological development go hand-in-hand. Most developmental disorders (mental retardation syndromes, learning disorders, etc.) have a neurological basis, and you will discuss these neurological bases when you take Lifespan Developmental Psychology (PY374). You will also discuss how children's brain development corresponds to their cognitive, emotional, and social development. In addition, the neuroscience course will give you a more fundamental understanding of the substantial brain-environment interactions that shape the brain throughout one's lifetime.

- **Personality and social psychology.** Modern social and personality psychologists work hand-in-hand with neuroscientists to understand the neural bases of individual differences and interpersonal interactions in psychology. In fact, it is becoming standard for the brightest young psychologists in these fields to be simultaneously trained in neuroimaging techniques, as these techniques are frequently employed in their research. There is, in fact, a new field devoted to such research: Social Neuroscience. If you were to open a social psychology journal, you would see at least one article (and probably several!) per issue that contains brain scans to support the authors' behavioral findings. You will particularly see research on brain areas involved in making moral decisions, interpreting someone's actions/intentions, differences in limbic system and cerebral cortex activation between introverts and extroverts, between prejudiced and non-prejudiced individuals, and so on.
- **Emotion.** One can study emotion on several levels, but invariably one has to come back to the underlying brain structures that give rise to emotions. This is an area of research that has grown tremendously in the last 20 years as neuroscientists have mapped out specific circuitry involved in emotion and motivation.
- **Learning/Cognition.** Although one can explore learning and cognition without reference to underlying brain structures, one's ultimate appreciation of these complex phenomena is greatly enriched by understanding the neural processes that make learning and cognition possible.

Required Textbooks

Diamond, M. C., Scheibel, A. B., & Elson, L. M. (1985). *The human brain coloring book*. New York: Barnes and Noble. [henceforth **DSE**]

The information in DSE, dealing primarily with neuroanatomy, is absolutely essential. The benefit of this book comes from coloring the assigned plates before the lecture in which the material is discussed. Although the act of coloring is quite time consuming (between 30 and 60 minutes per plate--no one ever claimed that learning was quick and easy!), it is the best way to remember the material. In the past, students who avoided coloring found themselves hopelessly lost (and frustrated) after only a short period of time.
You will need approximately 20-30 different colored pencils to color the plates effectively.

Bear, M.F., Connors, B.W., & Paradiso, M.A. (2007). *Neuroscience: Exploring the brain* (3rd Ed.). Baltimore, MD: Lippincott, Williams & Wilkins. [henceforth **Bear et al.**]

Bear et al. (2001) supplements the neuroanatomy in DSE with a broader range of information related to physiology, function, and neuropharmacology. At the beginning of each chapter is an overview outline; at the end of each chapter are key terms and review questions. You should take advantage of these study aids. Reading the chapter only once is not sufficient.

Haines, D.E. (2008). *Neuroanatomy: An atlas of structures, sections, and systems* (7th Ed.). Baltimore, MD: Lippincott, Williams & Wilkins. [henceforth **Haines**]

This atlas is very helpful for your laboratory sessions, and for most other aspects of the course—study the pages here as they are assigned on the syllabus. The atlas is intended to be a supplement to the other materials in the course; it contains more structural detail than we will cover in class.

Study suggestions

- (1) **It is highly recommended that you immediately form a study group consisting of 3-4 people.** Meet with each other daily to go over the lectures and the readings; quiz each other, help each other, and share your insights. This is the best way to become comfortable with the material, and will help you to gain an active knowledge of the material. Individuals in previous classes who did not work regularly in study groups had considerably more difficulty in the course than those who regularly participated in a group. Often, it is best to conduct such study groups in the laboratory, where you can get immediate assistance from the professors if you have questions.

A previous student noted the following—good suggestions to follow:

“I started out in two different three person groups but because of scheduling conflicts and figuring out who I better study with I ended up being in one two person group. I actually found two was most effective because in this process I figured out who I studied most effectively with and it was also a lot easier to schedule to meet especially since we met so much and for so long it was easier to find overlapping times with two people. We found that reading the lecture notes BEFORE the lecture (even though we didn't know what any of it meant) was good and took only 10 minutes, just to hear what we would be talking about. Then we would read the lecture notes and our class notes out loud and repeat things and just make sure it all made sense. Finally, we would read through again however this time we would switch off asking questions and quizzing each other. We did this every day for that days notes and then I would on my own go back and quiz myself again (and again:)) until I had memorized it. Groups were not as good for material that tended to be less complicated and more memorization as I found I did more of the straight up memorizing on my own. It was great for going over systems (like visual, olfactory etc) and going through the pathways and figuring out what is going on because it helps to talk about it and have someone else to bounce off ideas with. Also in lab after class, after I got to know people, we tended to ask questions and while we might be reading silently and not necessarily in a "study group" together, we would still always ask questions about that days lecture or reading or anything we were having a difficult time with. This helped both the person with the question and the person teaching the info. Much of the class did this both in lab and with slides, wet brain, etc. By the end of the class, I did more studying alone because I already understood a lot of the info and had a basis to build off of and knew what I personally was struggling with and needed to spend more time on. Group studying however for most of the class was very helpful.”

- (2) Do the reading and the coloring in DSE before the lecture. Above all, **do not get behind. The path gets cold very quickly!** Work at a consistent and steady pace throughout the course. **You cannot cram for the tests** and be successful—there is simply too much information. To integrate the information requires that you stay on top of everything and that you review constantly as you study new material. If there is something you do not understand, ask another student or the professors. This is a learning experience for everyone. The only stupid question is the one that remains unasked.
- (3) You should note that it is not sufficient for you to get just the "gist" of the information covered. At this level, you are also expected to know the details—and there are a lot of them. If you have not marked up your textbook, or taken copious notes, then you have not read the material thoroughly enough. You should read each Bear chapter at least twice before the tests, and study all of the assigned plates in DSE extensively. Coloring the plates quickly

may allow you to finish sooner, but probably at the expense of actually learning the material thoroughly. Learning takes time!

- (4) Use the **interactive computer programs** to review information covered in lectures, particularly with regards to the slides. Especially useful is the Brainstorm program--it will greatly facilitate your learning of the anatomy. Take advantage of these programs!
- (5) **Lecture notes** (and lecture slides) are available on the Neuroscience web page. You should go over the appropriate lecture notes for each day before you come to class; bring these lecture notes with you to class—they will assist you in taking notes. These notes should NOT take the place of your own notes. Many lecture notes also have sample questions attached for you to quiz each other on—these should help you to determine your relative knowledge of the material, particularly with regards to the Bear textbook.
- (6) There are many useful links on the Neuroscience web page:
<http://www.coloradocollege.edu/idprog/Neuroscience/Links.html>
In particular, we suggest the first link
(<http://library.med.utah.edu/kw/animations/hyperbrain/pathways/index.html>), which is good for reviewing many of the tracts you will learn in this course.
- (7) Exams will include information covered in the assigned readings, in labs, *and* in lectures.
- (8) When working in labs and going through the wet brain, you will learn the material better if you use the atlases to guide you.
- (9) Please observe professors' office hours, as these times are specifically set up for you to ask questions pertaining to the course.

Grading Procedures

The grades in this course will be based primarily on scores from four examinations. In addition, part of your grade will be determined by your participation in the Outreach program. **Note: Your grade in this course is based only on your mastery of the material, not on your perceived effort.**

All examinations are comprehensive, but will focus on material covered since the previous exam. Exams will cover material from the readings, the lectures, and the laboratory. SPELLING IS IMPORTANT, AND SPELLING ERRORS WILL COST POINTS. You should be aware that not all material in the readings will be covered in lectures. In particular, please do not underestimate the amount of material in the textbooks that will be covered on the tests (even if not explicitly discussed in class). If there is something in the reading you do not understand, please ask in class so we can discuss it.

Each exam will have a variety of question types (e.g., Multiple Choice, True/False, Identification, Short Answer, and Essay). Each exam will also have a wet-brain and/or a slide component, which cannot be made up.

Final grades are calculated as follows (of course, "+" and "-" will also be given when appropriate):

Exam 1	10%
Exam 2	20%
Exam 3	22%
Exam 4	33%
Gross anatomy LAB	3%
Micro anatomy LAB	2%
Finger twitch LAB	2%
Neuropharmacology LAB	3%
Mulligan stain LAB	2%
<u>Outreach program</u>	<u>3%</u>
Total	100%

with the following breakdown:

A =	90-100%
B =	80-89%
C =	70-79%
D =	65-69%
NC =	below 65%

A = Excellent work that reflects superior understanding and insight, creativity, or skill.

B = Good work that reflects a high level of understanding and insight, creativity, or skill.

C = Adequate work that indicates readiness to continue study in the field.

D = Marginal work, only minimally adequate, indicating lack of readiness to continue in the field.

NC = Failing work, clearly inadequate and unworthy of credit.

Note 1: No personal listening devices (e.g., iPods, CD players) may be used during the tests.

Note 2: If you have a disability and require accommodations for this course, please speak with the professors **as soon as possible** (preferably before the block begins) so that your learning needs may be appropriately met. Please keep in mind that due to the intense pace of the Block Plan, it is necessary to request accommodations in a timely manner to allow faculty and staff sufficient time to evaluate your request and implement reasonable accommodations. If you have not already done so, you will need to register with Disability Services (Learning Commons at Tutt Library, Room 152, 227-8285), the office responsible for coordinating accommodations and services for students with disabilities.

Note 3: The integrative take-home exams are designed to reinforce the material you are studying for the regular examinations, and to allow you to explore certain topics in a bit more depth. You will need to work on these throughout the block, NOT just the night before they are due.

Note 4: After tests are handed back, you may not talk to professors about the test for two days (unless the professors have made an obvious mathematical mistake on the scoring of the exam)—go over tests in your groups to figure out what you missed.

Outreach Program

The purpose of "Elementary School Outreach Program for Neuroscience Education" is to introduce local elementary school children (Grades 1-6) to basic neuroscience by providing them with hands-on experience with brain tissue at the gross and microscopic level. One belief behind this program is that the best way to learn material is by teaching it yourself. Another belief is that a well-rounded education at any level must include knowledge of how the brain works, and that this knowledge relates directly to how humans interact with each other as social beings. The sooner neuroscience education begins, the better. With this program, neuroscientific information can reach a very broad audience in the Colorado Springs area.

The requirements for this program are straightforward. You will work in groups of two–four. Through a series of meetings, you will organize your "presentation" for the elementary school children you will be meeting during near the end of the course. You will write an outline of what you plan to do; you will prepare at least one **original** poster to take with you for your presentation; you will take digital pictures of your outreach experience and email these to the professors after your outreach experience. Depending on accessibility to the elementary schools, you will meet with 1-4 classrooms.

The following summarizes our efforts since 1993, when the program started:

Number of classrooms visited: 561

Grades visited: generally, 1st through 6th; and some middle school children

Number of elementary school students involved: approximately 14,329

More can be found here:

<http://www.coloradocollege.edu/idprog/Neuroscience/Outreach.html>

Honor System

As is the tradition at Colorado College, examinations in this course are unproctored, but you will be required to take exams in the classroom. Any unauthorized use of materials other than your own brain (e.g., other students, notes) in the taking of exams is considered to be a violation of the Honor Code. Removal of tests from the testing room for any reason is a violation of the Honor Code and will be reported immediately to the Colorado College Honor Council. In addition, any unauthorized copying of an examination used in this course is strictly forbidden, as is use of any such copy to prepare for an examination.

Labs

Some laboratory activities are structured and **participation is mandatory**. Most of the time, however, the laboratories will remain open in the afternoons and evenings for you to work in groups and learn the material. Most afternoons, the professors will be available to answer any

questions your group might have--don't hesitate to ask if you need assistance during the professors' office hours. You will have access to at least one plastinated hemisphere from a human brain throughout the block. PLEASE TREAT THE BRAINS GENTLY—if you damage them, you will be asked to replace them (and they are expensive, approximately \$1,600/hemisphere). Brain atlases, embedded sections, and slides will be in the lab for your use. The purpose of the laboratory is for you to extend your knowledge beyond the textbook; to this end, each examination will include a slide and/or wet brain component to test your knowledge of actual tissue. UNDER NO CIRCUMSTANCES WHATSOEVER MAY YOU REMOVE THE BRAINS FROM TUTT SCIENCE 313.

There is a lab write up for each of the labs, constituting 12% of your final grade. These write-ups are designed to reinforce material from the labs themselves as well as other relevant material in the course.

WEEKLY SCHEDULE

- Notes:**
- (1) You are responsible for knowing this schedule. Complete all readings by the day and time they are listed.
 - (2) Plate numbers are provided for DSE; optional plates are within brackets; all other plates are required.
 - (3) Although topics are broken into rather circumscribed areas, you should realize that, ultimately, they all overlap with each other.
 - (4) Afternoons are OPEN LABS, that is, they are for you to study whatever you feel you need to study. Use this time to review material, to work in your study groups, and to ask the professors for help.
 - (5) There will be review sessions when tests are handed back; these will usually be held in the afternoon. Make note of these sessions in the syllabus.

BLOCK #1, WEEK #1

MONDAY (10:30 AM—after Opening Convocation): Introductions and Overview of the course; overview of the field of neuroscience

Bring this syllabus with you and make sure you have read it thoroughly

TUESDAY: Evolution of the human brain
Historical overview of neuroscience (Jacobs) [26 pages of text]

Bear et al. (2007): Chapter 1: Introduction to neuroscience (pp. 3-21)
Haines: pp. 2-8

PREVIEW: In this lecture, you will be introduced to the phylogeny of the central nervous system (CNS--consisting of the spinal cord and the brain), that is, how the brain has developed through evolution. This is important for understanding functional neuroanatomy and the field of evolutionary psychology.
Today's lecture also provides a brief overview of the history of thinking about the brain, highlighting some landmarks from antiquity to the present.

WEDNESDAY: Embryology (Jacobs) [9 plates; 53 pages of text]

DSE: 3-1 to 3-4; 3-7; 3-11; 9-3; 9-4; 9-11

Bear et al. (2007): Chapter 7: The structure of the nervous system (pp. 167-174; 178-203)

Bear et al. (2007): Chapter 23: Wiring the brain (pp. 690-697)

Haines: pp. 25; 52-63

PREVIEW: Here, we will explore the ontogeny of the brain, that is, how it develops within each individual. A great deal happens during the nine-month gestation period. Knowing the complex and critical nature of neural embryogenesis and early brain development will help you to appreciate and understand (1) the basic "components" of the brain, and (2) the relevance of this development for later mental abilities. In addition, a brief overview of gross anatomy is provided. We will also overview general gross anatomy.

THURSDAY: GROSS NEUROANATOMY LAB [7 plates; 43 pages of text]

DSE: 1-1 to 1-6; 5-44

Bear et al. (2007): Chapter 7 Appendix: An illustrated guide to human neuroanatomy (pp. 205-217, 232-235; self quizzes: pp. 236-240; 247-248)

Haines: pp. 13-30—focus on those pages with gross anatomy; 38

Group #1: 8:30-10 AM

Group #2: 10:30AM-12 PM

Group #3: 1-2:30 PM

PREVIEW: The primary purpose of the LAB is to let you see first hand what the brain looks like, and to point out the differences between textbook drawings and reality: there are no dotted lines in nature. Be sure to note the individual variation in the brains you examine. Each person's brain is as different as each person's physiognomy and personality--indeed, each person's brain **is** his/her personality.
Question: What makes each brain different?
Note: You are not expected to know everything in the lab handout by the end of the session; it will take you several days to have a firm grasp on the material covered in the handout--give yourself time to digest all the information.

FRIDAY: Neuromorphology (Jacobs); Intracellular organelles (Driscoll) [5 plates; 27 pages of text]

DSE: 2-1 to 2-3; 2-6; 7-2

Bear et al. (2007): Chapter 2: Neurons and glia (pp. 23-49)

PREVIEW: Neuromorphology is the study of neural structure. As interesting as gross anatomy may be, the real picture lies at the microanatomical level, which is a forest unto itself. Microanatomical structures have important stories to tell because it is at this level that all of the complex processing in the brain takes place. The main purpose of the lecture is to familiarize you with the necessary terminology. The microanatomical structures are important because many cognitive models take the neuron (= nerve cell) as their starting point. The neuron, which consists of *dendrites* (to bring information into the cell) a *soma* (the cell body, which integrates all incoming information), and an *axon* (to carry information away from the cell) is the building block of the brain. Consider how the shapes of neurons might relate to their diverse functions.

Equally important to the functioning of the neuron is the machinery within, the organelles that are responsible for housing and transcribing the cell's genetic material (the *nucleus*); synthesizing proteins (the *rough endoplasmic reticulum*); packaging proteins and neurotransmitters for transport to other parts of the neuron (*Golgi apparatus*); transporting neurotransmitters to the axon terminals (*microtubules* and *microfilaments*); and producing energy (the *mitochondria*) to fuel most of the cell's vital processes. Becoming familiar with the functions of these organelles will enrich your understanding of the processes that underlie cellular and synaptic physiology and pharmacology, which we will discuss in detail next week.

BLOCK #1, WEEK #2

MONDAY: Neurophysiology I (Driscoll) [2 plates; 23 pages of text]

DSE: 2-4; 2-5

Bear et al. (2007): Chapter 3: The neuronal membrane at rest (pp. 51-73)

PREVIEW: Neural structures are not static, nor do they operate in isolation; rather, they work together in highly integrated networks. Neurons communicate with each other in very elaborate and complicated ways. To understand how they communicate, you need to know the basics of neurophysiology, which focuses on the interaction (i.e., function) of the various components of the nervous system and describes how nerve cells respond to input and conduct signals. To begin this journey, we must first understand the forces that operate within a single neuron—the passive and active movement of ions and proteins across *concentration gradients* and *electrochemical gradients* that characterize the neuron at rest; and the events that lead up to and produce the sudden burst of energy called the *action potential* that sets the chain of inter-neuronal communication in motion.

GROSS NEUROANATOMY LAB WRITE-UP DUE AT BEGINNING OF CLASS

TUESDAY: Neurophysiology II (Driscoll) [26 pages of text]

Bear et al. (2007): Chapter 4: The action potential (pp. 75-100)

PREVIEW: Neurons are designed to respond quickly to stimulation...in the same way a drawn bow is ready to shoot an arrow. An elaborate, if not elegant, electrochemical system conducts impulses (known as *action potentials*) throughout the body. Today we will examine the action potential at multiple levels, from the structure and function of ion channels, to the dynamic flow of ions that characterize the phases of the action potential, to the movement of the signal down the axon to the synaptic terminal. Consider the following: how does this singular, “all-or-nothing” signal translate into sensations, thoughts, and actions? How does a neuron “know” when to fire an action potential and when to remain silent? We will begin to answer these questions today, but also keep the questions in mind for next time, when we discuss synaptic transmission.

WEDNESDAY: HISTOLOGY, MICROSTRUCTURE LAB

Group #3: 8:30-10 AM

Group #2: 10:30AM-12 PM

Group #1: 1-2:30 PM

Preview: The purpose of this lab is to expose you to some of the morphological variability that typifies neural tissue, and with a couple of the histological techniques for visualizing neural structures. Along with this lab, you should study the associated web pages.

ALSO: FINGER TWITCH LAB—sign up for one hour slots

THURSDAY: Neuropharmacology I (Driscoll) [32 pages of text]

Bear et al. (2007): Chapter 5: Synaptic Transmission (pp. 101-132)

PREVIEW: *Neuropharmacology* refers to the study of normal chemical synaptic transmission and the effects of drugs on the nervous system and behavior. The synapse (= bridge) is the structure by which neurons often communicate with each other; this structure forms the basis of most neurobiological research on learning and memory. Although there are several different kinds of synapses, we will concentrate on the most common kind: the chemical synapse. *Neurotransmitters* are chemicals that cross synaptic junctions, thereby allowing two neurons to communicate with each other, that is, to “transmit” information. These substances cross the synaptic cleft and bind to *receptors* on the postsynaptic neuron. There are many different types of receptors, and often a single neurotransmitter can bind to multiple types of receptors. Remember: it is the *receptor*, not the neurotransmitter, that determines whether a signal is “excitatory” (i.e., facilitates activity) or “inhibitory” (i.e., reduces or inhibits activity). Do not underestimate the importance of inhibition! A system without inhibition will simply not work because it will self-destruct.

Pharmacology does not end with the binding of transmitters to receptors; some of the most complex and interesting interactions take place inside the postsynaptic cell. *Ionotropic* receptors control the opening and closing of ion channels, while *metabotropic* receptors initiate biochemical cascades that influence the effectiveness of other receptors and can even increase or decrease gene expression in the nucleus. The latter effects are thought to underlie the formation of long-term memories and neuronal plasticity, both of which we will investigate later in the course.

HISTOLOGY LAB WRITE-UP DUE AT BEGINNING OF CLASS

FRIDAY: Neuropharmacology II (Driscoll) [45 pages]

Bear et al. (2007): Chapter 15: Chemical control of the brain and behavior (pp. 498-508)

Bear et al. (2007): Chapter 6: Neurotransmitter systems (pp. 133-166)

PREVIEW: Today we will discuss the anatomical localization of the major neurotransmitter nuclei and their projections, along with some drugs that influence these systems. Some drugs are endogenous, that is, produced within the body; others are exogenous, that is, originating from outside the body. Psychotropics, anesthetics, sedatives, hypnotics, stimulants, and other drugs produce their unique effects through their interactions with specific neurotransmitter systems. In order to appreciate the mechanisms by which drugs alter nervous system function, and diseases and insults impair it, it is important to understand how neurotransmitters and drugs interact with receptors and receptor complexes. For example, what makes one GABA receptor responsive to alcohol while another is responsive to anxiolytics? Why are some cholinergic receptors excitatory and others inhibitory? If glutamate receptors are important for learning and memory, is it possible to engineer “smarter” or “dumber” receptors by changing their composition?

FINGER TWITCH LAB WRITE-UP DUE AT BEGINNING OF CLASS

SATURDAY: 10AM: REVIEW SESSION—including a slide review

BLOCK #1, WEEK #3

MONDAY: TEST #1

TUESDAY: Spinal cord (Jacobs) [8 plates; 78 pages of text]

DSE: 2-9 to 2-10; 3-6; 4-1 to 4-4; 4-9

Bear et al. (2007): Chapter 7 Appendix: An illustrated guide to human neuroanatomy (pp. 226-229; self quizzes: p. 246)

Bear et al. (2007): Chapter 12: The somatic sensory system (pp. 387-400; 408-422)

Bear et al. (2007): Chapter 13: Spinal control of movement (pp. 423-432; 437-450)

Bear et al. (2007): Chapter 14: Brain control of movement (pp. 451-461)

Haines: pp. 85-95; 178-181; 184-185; 188-189

TUESDAY: 1 PM: Return and review tests

PREVIEW: Before information from the outside world can be processed in the brain, which sits in the dark cave of the skull, it must reach the brain. Thus, the primary questions today are: How does information get into the brain? What are the major processing steps along the way?

All information (except olfaction) flows from the peripheral nervous system (PNS) to the CNS. We will examine one example of an ascending (sensory) pathway through the spinal cord, and one descending (motor) system. These two systems are somewhat more accessible than other types of processing and illustrate the basics very clearly. You will be responsible for following the path of these two tracts through the nervous system; you are also responsible for the names and general functions of other ascending and descending tracts, but you will not have to identify them in cross sections.

As you learn how information is processed, consider how intricate the feedback loops are, and how intertwined sensory and motor systems are. This is especially true for something like language--think about how you are able to hear what you are saying and make very detailed adjustments in your speech based on what you hear and what you perceive the situation to be. Whether the topic is processing somatosensory information from the foot or information of a linguistic nature, the basic principles (e.g., sensory transduction, encoding, feedback, monitoring, updating of information, modifications of output signals) remain the same.

We strongly recommend the following web site:

<http://library.med.utah.edu/kw/animations/hyperbrain/pathways/index.html>

WEDNESDAY: NEUROPHARMACOLOGY LAB

Group #2: 8:30-10 AM

Group #3: 10:30AM-12 PM

Group #1: 1-2:30 PM

PREVIEW: This lab will introduce you to some of the basic techniques involved in *behavioral pharmacology*, or the study of the effects of drugs on behavior. Researchers who are interested in the unique influence of particular neurotransmitter systems on behavior can administer a drug that increases or decreases activity of that system, then measure the *change* in behavior that results as a function of the drug. We will investigate the paradoxical effect of the stimulant drug methylphenidate (Ritalin) on locomotor activity in rats, and discuss the potential mechanisms that underlie the effects we observe.

THURSDAY: Brainstem I—Gross anatomy and tracts (Jacobs) [8 plates; 35 pages]

DSE: 5-1 to 5-4; [5-5]; 5-6; 5-8; 5-9; 5-10

Bear et al. (2007): Chapter 7 Appendix: An illustrated guide to human neuroanatomy (pp. 224-226; self quizzes: pp. 244-245)

Haines: pp. 100-111; 118-125; 128-137

PREVIEW: The brain stem, which is absolutely essential for life, is an extremely complex collection of nuclei (= groups of cells with a shared function) and fibers (= the “telephone wires” carrying signals). It consists of the medulla oblongata, the pons, and the midbrain. We will follow the two tracts we discussed previously (DCML and Corticospinal) as they traverse through the brainstem. In addition, we will briefly cover a couple of the more obvious nuclei, their functions, and other landmarks along the way.

FRIDAY: Brainstem II—Cranial nerves and nuclei (Driscoll) [8 plates; 37 pages]

DSE: 6-1; 6-3; 6-4; 6-11 to 6-13; 6-23; 6-24

Bear et al. (2007): Chapter 7 Appendix: An illustrated guide to human neuroanatomy (pp. 232-233; self quizzes: pp. 247)

Lecture notes: read the lecture notes for this lecture before class

Haines: pp. 24; 50; 104-111; 176-177; 190-191

PREVIEW: An important part of the brainstem is the cranial nerves, of which there are 12 pairs (I through XII). On many levels, the cranial nerves are to the head what the spinal nerves are to the rest of the body: they transmit a wide variety of (sensory and motor) information to and from the brain. However, the information carried by the cranial nerves is somewhat more detailed and specialized. In addition to learning the basic origins and destinations of these nerves and their brainstem nuclei, we will investigate in detail the pathways of two of these nerves.

BLOCK #1, WEEK #4

MONDAY: Thalamus (Jacobs); Hypothalamus (Driscoll) [7 plates; 34 pages]

DSE: 5-16 to 5-22

Bear et al. (2007): Chapter 15: Chemical control of the brain and behavior (pp. 481-497)

Haines: pp. 140-155

PREVIEW: With the exception of olfaction, all information coming into the cortex must pass through the thalamus, which serves as the great "portal" to the cortex, and functions as a processing/relay station. The thalamus may be the earliest level at which sensations attain consciousness. This structure is composed of many nuclei, each responsible for a different kind of sensory information or processing function, and each with specific cortical interconnections. There is, in fact, a continual interchange of information between the thalamus and the cortex. The hypothalamus is a favorite structure for psychologists because of its wide-ranging functions. In brief, it controls our body adjustments in relation to our external and internal environment (internal homeostasis). It regulates body temperature, hunger, thirst, sexual activity, goal-seeking behavior, endocrine functions, affective behavior and the activity of the visceral nervous system.

TUESDAY: 10 AM: REVIEW SESSION—including a slide review

WEDNESDAY: TEST #2

*****BLOCK BREAK*****

Note: We strongly suggest you review material during block break that you are still not completely comfortable with, and that you work ahead with the new material.

BLOCK #2, WEEK #1

MONDAY: Cerebral hemispheres and (neo)cortex (Jacobs) [4 plates; 21 pages of text]

DSE: 5-29 to 5-32

Bear et al. (2007): Chapter 12: The somatic sensory system (pp. 401-408)

Bear et al. (2007): Chapter 14: Brain control of movement (pp. 459-464; 468-472)

Haines: pp. 14-15

PREVIEW: In discussions of so-called “higher” cognitive functions, the cerebral hemispheres, and specifically the (neo)cortex, are the primary focus of attention. Today, you will be (re)introduced to the basic structural, organizational, and functional characteristics of the cortex at both the gross and the microscopic level. We will build on these characteristics when we talk about audition, vision, learning/memory and emotions, so it is important that you understand the fundamentals.

In the cortex, one can distinguish between motor areas (those concerned with muscle movements), sensory areas (those concerned with processing of a specific sensory modality), and association areas (those concerned with integration of different sensory modalities, and/or sensorimotor integration). It is very likely that many of the qualities we most (and least!) “value” as humans [e.g., language, cognition, abstract reasoning, forethought, personality, humor, intelligence, social skills, greed, jealousy] are mediated quite intimately by association cortices.

MONDAY: 1 PM: Return and review tests

TUESDAY: Cerebellum (Jacobs) [3 plates; 24 pages]

DSE: 5-13 to 5-15

Bear et al. (2007): Chapter 14: Brain control of movement (pp. 472-478)

Bear et al. (2007): Chapter 25: Vertebrate models of learning (pp. 772-776)

Haines: pp. 36-37; 80-83; 222-225; 228-229

PREVIEW: Two other structures that work closely with the cerebral cortex are the basal ganglia and the cerebellum, both of which are intimately involved in motor control. Recent research suggests that these structures are also involved in sensory, cognitive, emotional, and learning processes.

The cerebellum (= little brain) receives direct somatic sensory information from the periphery, and this input hints at its function: control and coordination of very rapid muscular activities such as running, typing, playing the piano, and even talking. The cerebellum has a very extensive and rapidly acting input and output system. Loss of this area causes almost complete incoordination even though there is no paralysis. We will explore the circuitry of the cerebellum in some detail because it is one of the best understood of all brain structures, and illustrates rather dramatically the importance of inhibition in neuronal networks.

WEDNESDAY: MULLIGAN'S STAIN LAB [18 pages]

Bear et al. (2007): Chapter 7 Appendix: An illustrated guide to human neuroanatomy (pp. 218-223; self quizzes: pp. 241-243)

Haines: pp. 66-74

Group #2: 8:30-10 AM

Group #1: 10:30AM-12 PM

Group #3: 1-2:30 PM

PREVIEW: The Mulligan stain is a gray matter stain that allows one to clearly see the demarcation between gray and white matter. We will be staining coronal sections of the cerebrum and brainstem structures. This will allow us to see subcortical structures (e.g., basal ganglia, hippocampus, amygdala) that cannot be seen on surface anatomy.

THURSDAY: Basal ganglia (Driscoll) [2 plates; 29 pages]

DSE: 5-24 and 5-25

Bear et al. (2007): Chapter 14: Brain control of movement (pp. 464-468)

Bear et al. (2007): Chapter 24: Memory systems (pp. 751-754)

Haines: pp. 146-159; 234-239

PREVIEW: The basal ganglia are subcortical structures that are involved in the integration of motor activity and the programming, initiation, and termination of such activity. In general, the basal ganglia inhibit motor tone by transmitting inhibitory signals both to the motor cortex and the lower brain stem. However, both excitatory and inhibitory loops through the basal ganglia act in concert to aid in the initiation and termination of movement. When a plan for an important movement reaches the basal ganglia, the basal ganglia shut down inhibition to allow excitatory signals to travel from the thalamus to the cortex. With widespread destruction of the basal ganglia, muscle rigidity throughout the body results. The basal ganglia also appear to be intimately involved in procedural memory.

FRIDAY: Limbic system: amygdala (Jacobs) [1 plate; 23 pages of text]

DSE: 5-26

Bear et al. (2007): Chapter 18: Brain mechanisms of emotion (pp. 563-583)

Haines: pp. 258-259

PREVIEW: The cortex does not function by itself. In addition to the reciprocal connections with the thalamus and basal ganglia discussed previously, the cortex functions efficiently only because of its complex interconnections with other (subcortical) structures. These structures communicate with each other through an elaborate series of reciprocal connections (loops) that permit constant monitoring and adjusting of the information flow. Input and output are continually compared in these loops to insure that the system runs smoothly.

There are three "qualities" without which cognition as we know it could not exist: emotions, motivation, and memory. All of these are intimately linked to what is known as the "limbic system," a rather broad range of interconnected cortical and subcortical structures. One purpose today is to introduce the amygdala, which is crucial to emotions and our affective evaluations of sensory stimulation.

Think about the following: The limbic system leads; the cortex follows.

BLOCK #2, WEEK #2

MONDAY: Hippocampus (Driscoll) [2 plates; 57 pages]

DSE: 5-27 to 5-28

Bear et al. (2007): Chapter 24: Memory systems (pp. 725-750)

Bear et al. (2007): Chapter 25: Molecular mechanisms of learning and memory
(pp. 761-771; 776-793)

Haines: pp. 256-257

PREVIEW: The hippocampus (=sea horse) is another favorite structure of neuroscientific research, due to its purported role in the laying down (consolidation) of declarative memories. For those who sustain damage to this structure, life essentially stops at the time of the insult. Imagine not being able to make new friends or keep track of what you have said or done. However, memories made prior to the damage tend to be spared, suggesting that memories are not stored in the hippocampus. If not here, then where?

Today we will explore the molecular, physiological, pharmacological, and anatomical bases of memory. Much of the research that contributed to our current knowledge of memory formation has been conducted in the hippocampus, although vital contributions have also come from invertebrate sensorimotor circuits.

TUESDAY: Visual system (Jacobs) [2 plates; 69 pages of text]

DSE: 6-6 and 6-7

Bear et al. (2007): Chapter 9: The eye (pp. 277-308)

Bear et al. (2007): Chapter 10: The central visual system (pp. 309-341)

Haines: pp. 244-247

PREVIEW: Vision has received more attention than any other area of neuroscientific research and, as a result, is one of the more understood areas. In many ways, visual processing serves as the paradigm for all types of sensory processing. Many cognitive models (e.g., connectionism, neural networks, perceptrons) would not be possible without the knowledge that has been gained from the study of the visual system. As you study this area, think how similar processing techniques (e.g., parallel and hierarchical) could be involved in the processing of other types of sensory information.

WEDNESDAY: OUTREACH PROGRAM

YOU NEED TO RESERVE THE ENTIRE DAY FOR THIS

Note: Your group also needs to make one original, high quality poster for this activity. Also, please take digital photos of your presentation and the children's participation in the program. Let us know in advance if you need a digital camera.

THURSDAY: Neuroplasticity (Driscoll) [1 plate; 31 pages of text]

DSE: 3-12

Bear et al. (2007): Chapter 23: Wiring the brain (pp. 689-691; 697-723)

Haines: pp. 243

PREVIEW: “Plasticity” refers to the ability of the nervous system to change in response to developmental cues, sensory input, motor activity, learning, and physical or environmental insults. Not all plasticity is growth—neurons, dendrites, synapses, and receptors also die in response to internal or external cues, from prenatal development throughout adulthood. Some “pruning” is, in fact, a necessary part of our nervous system’s ability to refine its connections—a sort of “use it or lose it” process. Although the brain changes throughout our lifespan, “sensitive periods” of increased plasticity in specific regions of the brain are thought to contribute to our learning abilities for certain types of material (such as language) at particular ages.

MULLIGAN STAIN LAB WRITE-UP DUE AT BEGINNING OF CLASS

FRIDAY: Chemical senses (Driscoll) [3 plates; 25 pages of text]

DSE: 6-5; 6-16; 6-21

Bear et al. (2007): Chapter 8: The chemical senses (pp. 251-275)

PREVIEW: Less is known about **gustation** (taste) and **olfaction** (smell) than about vision, audition, or somatosensation. However, this does not mean that there is nothing interesting to learn! For example, approximately 3% of the mammalian genome is devoted to the coding of olfactory receptor types, and thousands of these receptor types have already been identified. In addition, have you ever wondered why odors evoke such strong emotional memories? Both the gustatory and olfactory systems are highly interconnected with the limbic system. Very recently the specific receptor proteins involved in several of the taste transduction mechanisms have been identified, so research in this area is intensifying.

SATURDAY: 10 AM: REVIEW SESSION—including a slide review

BLOCK #2, WEEK #3

MONDAY: TEST # 3

TUESDAY: Auditory system (Jacobs) [2 plates; 35 pages of text]

DSE: 6-17 and 6-18

Bear et al. (2007): Chapter 11: The auditory and vestibular systems (pp. 343-375)

Haines: pp. 250-251

PREVIEW: Today we will discuss the specialized sense of audition. The importance of this sense is obvious: it is the primary (but certainly not the only) sensory mode through which language is normally acquired. In general, we will discuss how sound, in the form of physical waves devoid of any inherent meaning, is transformed in the ear into the electrochemical signals that the brain can interpret. We will trace the flow of information from the brain stem into the primary and secondary auditory cortices. Auditory information is subjected to a great deal of processing before it even reaches the cerebral cortex. It is important to know at least the basics in order to understand psycholinguistic experiments (e.g., dichotic listening). Once the signal reaches the cortex, it receives additional processing (in the primary auditory cortex) and is integrated with previously stored information (in secondary auditory cortices such as Wernicke's area, the angular, and supramarginal gyri).

TUESDAY: 1 PM: Return and review test

WEDNESDAY: OUTREACH PROGRAM

YOU NEED TO RESERVE THE ENTIRE DAY FOR THIS

Note: Your group also needs to make one original, high quality poster for this activity.

THURSDAY: Language and Neuroimaging (Jacobs) [40 pages of text]

Bear et al. (2007): Chapter 20: Language (pp. 617-642)

Bear et al. (2007): Chapter 7: The structure of the nervous system (pp. 174-179)

Bear et al. (2007): Chapter 19: Rhythms of the brain (pp. 585-590)

Haines: pp. 76-80

PREVIEW: Perhaps the most human of all characteristics is (human) language, a skill that has certainly received considerable attention in psychology and in the neurosciences. Today, we will explore the classical view of how language functions in the brain (i.e., Broca's area and Wernicke's area) along with some more detailed aspects of language as revealed by neuroimaging studies. Language is certainly not confined to the classical language areas; indeed, a very large number of neural structures are probably involved in language in some way. Today, we will also outline some of the basic imaging techniques such as PET and MRI, along with their relative strengths and weaknesses. These techniques have revolutionized our understanding of the living, functional brain.

FRIDAY: Comparative neuroanatomy (Driscoll)

PREVIEW: To date, the majority of neurobiological, neurophysiological, and neurochemical research is conducted in non-human animals. For example, applied research (research designed to directly benefit the human condition) relies on the use of “animal models” to understand pathological processes that occur in the human nervous system and to test potential therapies. If you attend graduate school in neuroscience or biological psychology, it is very possible that your advisor will do research on non-human animals rather than humans. We will explore the similarities and differences between human and non-human neuroanatomy, with particular attention paid to the rodent, which is one of the preferred model organisms in neuroscience.

BLOCK #2, WEEK #4

MONDAY: 10 AM: REVIEW SESSION—including slide review

TUESDAY: REVIEW DAY—consider this an additional study day

WEDNESDAY: FINAL EXAM

Guide to Interactive Computer Programs

The interactive programs listed below are generally self-explanatory. To open these programs, simply double click the mouse on their icons on the desktop—these programs are on the I-Macs in Tutt Science 313 only.

Brainstorm 3.0

This is simply the best and most appropriate program for the course. **Use it!** You will find it immensely helpful from the 3rd week on, especially with regards to cross sections of the spinal cord and brainstem. The program is self-explanatory; it should be easy for you to navigate.

Haines Anatomy

This is basically a computer version of the Haines atlas.

IPod users....

You might find the following of interest: <http://www.sylvius.com/ipod/>

Advice from former students

The following are selected quotes from former students. You should reread their advice a couple times throughout the course, and take what they say seriously.

- Don't underestimate the depths of substance abuse, malnutrition, and general selfdestructive habits you will form for this class. It is best to embrace them and run with it (ulcers and all). Figure out how you learn/MEMORIZE material best BEFORE the class. The workload will burn you, but make it a habit. Seek one on one partners to keep eachother going. Maybe even take turns teaching previous lectures to eachother. Stay organized. The material is incredibly interesting, but it is a non-stop flow. Try to keep you head above water. Buy the necessary supplies, and hunker down in your respective bomb shelters for the next two blocks.
- Breathe. it is easy to panic. It is even easier to completely break down. Overall when the class is finished you will feel very lucky to have been forced to learn so much in such a little time, and freaking out will not make that sigh of relief come any faster. Be sure to memorize EVERYTHING, regardless of how much Bob and Lori spoke about it in class. If it does not apply to the automatic material, it will sometime down the line.
- Don't fight it. Accept that you're going to have to give your life over to this course, and don't resent it the whole time, or you're seriously in for two months of hell. Figure out what material works best for you, and use that material. There's so much available, don't feel like you need to use everything. I found that diagramming critical information and

structures from each lecture on whiteboards or chalkboards was very helpful. Also, my study group saved my life in this course--we pretty much became each others' family. It would have been a lonely two blocks with just me and my textbook. If you can stand it, try to review the material before and after the lecture, because you'll retain it much better that way. Remember that you'll get out what you put in, and you can get more out of this course than almost any other at CC.

- Find a way to integrate the material in an enjoyable manner
- Don't stress out. Its easier to learn the information if you think in terms of the fact that you have a brain, and everything you are learning is actually going on in your body and its cool to know exactly what is happening and why its happening.
- Ok, first of all, don't freak about about all of the other advice from former students. The material you will learn in this course is not conceptually difficult- there is just so much of it! Prepare yourself- you will be memorizing literally thousands of pieces of information these next two months. But don't worry- you can do it! Besides, you won't have a social life to distract you from your studies!
- Do not be intimidated by what you have heard about this class. Yes, you do need to devote an inordinant amount of time to this class, but there is nothing conceptually difficult. If you work hard, ask questions, and have fun you'll be amazed at how quickly the class goes by. Most important thing you can do for yourself: form one or two study groups the first day and work your ass off every other day.
- Do not forget about the slides!!! They seem innocent, but will bring you down in the end if you neglect them.
- I would tell other students that this course is hard and extremely time consuming. I would tell them to study everyday like there is a test the next day, to always work hard and not to get discouraged when the grade on your test does not reflect your hard work. In the end it is a great class and you will learn a lot.
- Calm down, it is doable. Try to prepare as much as you can over the summer (coloring book, note cards) but also enjoy your summer because you won't have much of a life in neuroscience. It is very likely that you won't find out your own best method of study until the end of the block but don't panic if you study differently then other people in the class, all that matters is that it works for you. Color coding helps. If study groups work for you form one, they are the only people that will laugh at your jokes (or even understand them). They are also the people you become very close with/spend all your time with. Some people just don't study well with others; this is not a bad thing. Find different study places you can be productive in, you will spend more time here than you spend in your own bed. Review your notes everyday to make sure there are no holes and that everything makes sense. Try to memorize and understand everything day to day because cramming is not possible. Try not to think about this class in terms of grades. Use grades as a motivation but if you see everything as material you want to learn rather

than a grade you need to get it takes some of the pressure off and helps you focus on learning the material. As Lori said the first day, "Don't freak out, just do it." And never get too confident after a good grade on a test, study harder for the next one.

- Read the book after the lecture because it'll seep in better and you'll actually understand what you're reading. Use Brainstorm for your slide review it's awesome!
- **STUDY....STUDY....STUDY.** Don't take a day off, even if you've done well on an exam and feel like celebrating. Material is covered very quickly and it all requires past lectures to understand. Make sure you prepare for lectures in advance and review them that afternoon....don't fall behind. Use your weekends wisely. They offer a lot of time to consolidate your knowledge----be weary of birthdays, homecoming, and other 'extracurriculars', they could ruin your chance to get ahead....or catch up over the weekend. All this said, remeber that it is not impossible. your understanding reflects the time you put in....study a lot, study efficiently.
- Study. Sleep. Eat. Love Coffee. Go out at some point. Do not give up. I mean, I havent gone online in 2 months because of this course, and I used to spend a lot of time on the webcam with my parents/ staring at my dog... but I havent been able to do that. But the sacrifice is probably worth it.
- Accept absolutely as much as you can about this course- it's going to suck up your life, you'll find that you won't have the time or energy for break downs, and each test will actually blow your mind more than the last one did, although that won't seem possible after the first. I believe that Lori and Bob actually work almost as hard as we do in this class- and we only take it once, so learn to appreciate their work, and learn to respect them. Find a million sources of motivation and work your way through them one at a time. If you're miserable, don't be afraid to drop it, and if you fail don't be afraid you're a failure- and I don't think Bobs as big a hard ass as he comes across.
- The class lectures are essential so pay critical attention in class. It would be beneficial to read Bear before the next day's lecture in addition to rereading it after lecture as well. Review your notes as often as possible. i would recommend doing the coloring book, especially for block one over the summer, but to remember to review these plates during the school year, that way you are wasting less time coloring and more time studying what you have colored. study groups are necessary and don't get behind. use the lab day afternoons to catch up when necessary.
- **THIS CLASS IS PASSABLE.** And believe me, a few weeks ago, I wouldn't have thought it was. Bob and Lori are willing to help you, but no one will be as much help as the other students. Form a study group and meet as often as you can...even if that just means that you do your readings in the same room. Often having another student there to answer a question can make all the difference. Learn the information the day of the lecture. Find out what studying method works best...should you read the material before or after the lecture (after worked best for me)? **DRILL THE SLIDES!!** Slide questions will be the

largest portion of every test, and knowing the information in the slides will help you on all of the other sections of the tests as well. Good luck, and enjoy!

- The hardest part of this course is filtering through all the large amounts of information thrown upon you everyday in lecture. You can't possibly know everything that you read about in the textbook, therefore, paying attention to key points is critical. Pay close attention to what Lori and Bob emphasize in the lecture, memorize everything you learn about in the labs, and look for reoccurring themes throughout the course. Get to know Bob and Lori's brains too, and figure out what it is they want you to know for the tests! Also take advantage of all the resources you have available to you, from help with tutors to all the links and slides on the website. You pay thousands of dollars for this course, so get your money out of it. Especially go visit Bob and Lori during their office hours. At large research universities, rarely do you have the chance as an undergraduate to talk to your science professors directly without going through someone like a TA. At CC, Bob and Lori are sitting in their offices everyday waiting for you to come talk to them. If you really wanted to - because I don't think many students take advantage of their office time - you could probably go there everyday and have two very experienced, PhD level tutors for an hour or so all to yourself. We'll probably never have that opportunity again! They want you to talk to them and, like everything at CC, they are here to cater to you.
- Do the assigned reading and homework, even if it isn't graded...
- First of all, take the advice of Bob and Lori and previous students seriously from the very beginning. Minimize/eliminate other commitments because this course is extremely time intensive. Memorize, memorize, memorize, and drill, drill, drill the information. Go into office hours and ask Bob and Lori questions. Have the tutors quiz you. Have your classmates quiz you. Draw on the white boards and quiz yourself. Look at slides every single day. Be prepared for late nights and lost weekends. Most importantly though, go into this with a positive attitude and keep a positive attitude throughout! It will be worth it in the end when you realize just how much you've learned!
- It's a very tough course, but it ain't impossible. Make sure to do that little bit of studying every night, I found that going over the lectures that day later that night helped to consolidate it. Sleep matters, so get your z's. I found Haines to be not helpful at all, but a thorough reading of the textbook to be very helpful on multiple choice. I didn't do the coloring book, so I don't know if it was helpful. Study the slides, drink caffeine, hang out at least once a week.
- Don't stress about studying - just do it. Enjoy the learning process and study the slides for the tests.
- Study the material everyday over and over again. Study groups and are essential. Follow Bob's and Lori's advice of being active learners. Drawing the material on boards and talking with people about it helps.
- Study hard, study often...pray you only have to take this course once.

- Practice tracts and constantly practice the slides. Look at them a little everyday, so that you won't be cramming on the night before each exam. They are always a big part of the exams. Be sure you know the lecture the day it is given so that you won't fall behind, because it's really easy to lose track.
- Study as much as possible, and never ever ever procrastinate. Enjoy the class no matter what. It makes the subject matter easier to learn.
- Your interest in the subject is the greatest motivation to learn.
- After lecture and before beginning the next day's reading, get that days' material DOWN PAT. it will save you so much pain and heartache later on when you're trying to learn new material and really understand information from three days ago. stay on top of things, not just reading and notes wise, but really soak in the information on a day to day basis.
- If you buy in to the fear everyone tries to instill in you, the first 2 weeks are going to totally screw you up mentally. Instead, I would go into the class with the understanding that yes, it will be hard, and yes, it will take a lot of your time, but it is doable. Don't think the best you can do is pass, because if you put all you have into the class, chances are you are going to be able to get a very good grade. The stuff about "do the coloring book over the summer or you will fail" is to me, untrue, as there is enough time to do the coloring while taking the course, and I would recommend it as it will help enhance your knowledge of the material. The most important advice I can give is to not fall behind, to do atleast some work every day, and to remember to relax once in awhile! The class is over before you know it, and the information you gained from taking this class will penetrate every aspect of your life. So enjoy it!
- Study every single day and review lectures.
- Overall this course actually wasn't as bad as I thought it was going to be. Know that you are going to have to work and just buckle down and do it. BUT don't forget to take a little time of to clear your mind, sleep, and still have a little fun. This course doesn't have to fully consume your life. In fact, I think you will learn more and be better off (healthier and saner) if you don't let it. You will be amazed by how much you learn, even if you hated it along the way. Grit your teeth and enjoy.
- Do not stress! It takes to much energy and time to stress over the material. If you continously review everything, you will know it. Everything takes practice.
- Understand that this is the hardest class you will take and treat it like that from beginning to end. But, if you just buckle down, don't have much of a social life, and study every day like you have a test the next day you will be just fine. Enjoy it and learn as much as you can!

- Prepare yourself mentally for an extremely time consuming course. Study with people to make it more meaningful active.
- **BE ON TOP OF THE MATERIAL**
- Study like you have a test every day, and repeat old material that you do not feel comfortable with. Take one sanity night off a week, but never take a whole day off...you will drown in this class if you do not keep up with new material. Try not to over-stress, freaking out does not help at all...just keep after it, and you'll be amazed what you'll learn! (ps. try not to focus on your grade, but focus on learning the material...if you put everything you have into this class, the grade will work itself out without you worrying about it)
- Give this class more effort than any other course. It is extremely difficult in its time demands. Save some motivation for second block, first block is the easy/boring stuff.
- Don't cram
- Mentally prepare yourself to devoting your next two months to a completely new lifestyle of energy drinks, bad jokes, new friends, and a serious, **SERIOUS** wealth of knowledge **ONLY** if you're willing to put the time in. If you truly can give it your all, this will be one of the greatest classes you'll have ever taken...
- Don't get behind. Do all of the assigned readings, and read the provided lecture notes. I find it better to skim before class and then do a thorough reading of the material after class.
- don't slack. it is completely conquerable. don't let your fears or what you've heard about it interfere with what you need to do. enjoy it. don't let it consume you. find a balance!
- Just know coming in that this will be the hardest undergraduate class you will ever take, especially if you have extracurricular responsibilities.
- First of all, when studying, do not just try to memorize the material. Constantly try to integrate the concepts and take your understanding to the next level, because that is what you will be tested on, and that is the nature of the subject. read all of the text, although it may seem too time consuming and find study partners that you work well with. do a little each day instead of trying to cram...it will not stick if you procrastinate. pay attention to figures in lecture and the text and study anything that could possibly be a slide question!
- Study the coloring book for complete diagrams of important pathways, etc. It helps make things more clear. Read the Bear textbook **VERY** carefully **AFTER** the lecture. This consolidates the lecture information, while adding a few memorable details. Read the lecture notes before class. It helps with taking your own notes, because you have seen the words before. Don't follow your lecture notes during lecture. Otherwise, you won't write anything down during class and you will miss important points that aren't in the notes.

Don't assume you will remember ANYTHING! WRITE IT DOWN! Things pile up very quickly. Also, KNOW the information the day the lecture was given. This will save MAJOR headaches the night before a test. Also, realize that even though normal people are outside are doing normal things, they will never have the knowledge that you have, so commit to this class and don't look out the windows at people that actually see sunlight. It will only depress you. Use your study group, if only to have people to bitch with. It helps more than you realize to have other comrades with no lives. Make fun of yourself. This may keep you sane, because as soon as you stop, you will assume that normal people are in the lab on Friday AND Saturday nights. This, my friend, is not the case. Enjoy the class and don't drop it if you fail the first test. Just light a fire under you ass, get some Red Bull and learn, learn, learn.

- DO NOT TAKE A DAY OFF EVEN THOUGH IT IS TWO BLOCKS. Everything you learn at the beginning of the course will setup the foundation for what you learn later in the course. If that foundation is shaky then expect to have trouble grasping the material that follows. Carefully read the textbook and take notes while you read. Spend afternoons in the lab and if you don't understand something DON'T BE AFRAID TO ASK BOB OR LORI. This is something I regret not doing more often. Also meet with your study groups everyday including weekends and for at least 2 hours. Review everything not just the day's lecture because the tests are comprehensive. Study the coloring book because it will help you remember structures and tracts. This class will be challenging and be prepared to learn alot. If you dedicate the time and effort to this class you can do well. Bob and Lori are awesome professors and are there to help you do well.
- WHEN YOU FORM A STUDY GROUP - make plans about how the group will be conducted/ what you want the group to function as FROM THE BEGINNING. Without this, the study group is doomed to be a scheduled time to learn the information rather than to DRILL/STUDY the information. The study group works best when everyone comes with some understanding and any questions after having become somewhat familiar with the material(i.e. not just having listened to the lecture). DON'T GET BEHIND - In the first block it is really important to solidify the information as you go and not to slack on practicing it on a regular basis. Everything is comprehensive so the information that you have in the beginning will not only appear on more of the tests than the later information but it genuinely facilitates learning of more complex information that occurs later in the course. READ THE BOOKS (DSE & BEAR et al.) - The tests engage the information in a very different manner than you will initially expect. Obtain a FUNCTIONAL UNDERSTANDING of the material (i.e. practice thinking about it in different ways, from different angles as opposed to just drawing and memorizing everything "as is"). This type of understanding should really help the details become more logical and even less intimidating.
- This is the best course I have taken and I know you will be proud of yourself once you know the information. You will be excited to be done with the course, but you will be super sad to finish the class because of the great relationships you develop with your classmates and professors. This class is intellectually challenging, but Bob and Lori are

always there for you as needed. Lori was very supportive because I would go and talk to her when I felt somehow depressed or something. She had the ears to listen and the smile to cheer you up. Bob was absolutely amazing in all his lectures. Get to know this guy, he is really great because he gets you excited about the work you are doing. I had a great time knowing him and I hope I will get to know him even more after this class. Enjoy!!

- First: this course is survivable, and passable, IF you put in the time and effort. Study EVERYDAY - yes, even Friday and Saturday, for if you don't, it will come down to crunch time and this is not a course you can cram for! You don't entirely have to give up fun - just alter it a little. For instance, if you are not opposed to drinking, try playing "Circle of Death" with neuroscience flash cards on a Friday night. **THIS WILL NOT SOUND LAME ONCE YOU HAVE BEGUN THIS CLASS!!** Also, WARNING: your sense of humor will no longer translate to your non-neuro friends. You may well find yourself rolling on the floor laughing when you realize that "the F-Word" is FASCICULUS. Lastly: Form a study group. First day.
- Do study every night like there is an exam the next day. That doesn't mean stress out, that just means know your info so when you study for the exams its more just a review than learning ALL the material. Also don't burn yourself out. And don't let the course intimidate you. If you go into it thinking the best you can do is passing, you will just limit yourself! its definitely a doable course. The work isn't overwhelming. Its doable amounts every night so just do it!
- First take the former students advice seriously. This class will be tough. It will require more time then any other class you have taken so far. Just because you have afternoons off doesn't mean you can put off the work til later. Once class starts rolling there is no slowing down til you hand in your last test during 2nd block. My advice is do the coloring book before the class starts. You won't know what any of it means but by the end of class you will. Also read the Bear textbook over and over again. Take notes while you read and don't ignore the little details. Everything is fair game on the test including the diagrams and green boxes. Just know everything. Also if you're having any problems ask Bob and Lori. They want you to do well so don't be afraid to ask. You can pass this class it just requires lots of time and dedication.
- Make this class your number one priority and be totally prepared to sacrifice time with friends, sleep, adjuncts, sports, and clubs during the two blocks it takes. Do not go into the class with a full schedule of many other things that you plan to do. It will take all your time, but it will be fascinating, fun, amazing and a great experience. If you like to work and if you are good at working hard you will do fine in the class and understand it. You may not end up with the grade you want, but let that motivate you to work harder and better. As you work be healthy and make sure to exerise a couple times a week and take one night off to have fun, but you will regret it alot if you do anything that night the will impair your concentration the next day. Being tired, sad, or hung over the next day will cost you vast amounts of valuable time. So even on weekends, make sure to get at least 7 hours of sleep a night, wake up early and keep naps short. Take this class as a great and

wonderful challenge, take it as an adventure and as a quest and you will be both amazed and excited by what you learn.

- This course will consume your time like no other course at CC, but you will love it. Bob and Lori are amazing and will help you every step of the way. The most important thing you can do for this course is to use your time effectively. Figure out the best way to study so that you can retain the material. I eventually used the coloring book as an interactive review the night after we covered it in class. You will learn nothing this course if you don't put in context. At the end of the day, remember that the thing that you will be poking with little wood sticks is the human brain: a life, a history, a personality. What more could you want?
- Know the slides!!! Practice them, then practice them again, and again and again so that they become second nature. If you do great on the slides, you're bound to at least get a passing grade since you can just flip a coin on the true/false section and get some right. Oh yeah, did I mention to know the slides???

Student contract

Note: This sheet must be turned in to the professors by the second day of the class.

I have read and understand the requirements of this course with regard to the following (initial each):

_____ All examinations are comprehensive in nature and will thoroughly test my knowledge/understanding of the material (learning just the gist is not enough).

_____ All grading in the course is done blindly; grades are based entirely on my demonstrated knowledge of the material, and not on my perceived effort involved in doing the work.

_____ The Honor System, including that removing tests from the testing area is an honor code violation and will be reported as such.

_____ In studying the brain, a wide variety of behaviors and disorders will be discussed; a few of these topics could make some students uncomfortable (which is different than being challenged). The professors will make every effort to help you understand the material (including classroom demonstrations involving students), but will never purposely do anything to make you uncomfortable. Moreover, the professors are not responsible for the opinions expressed by other students.

_____ I will only put my student ID# (not my name) on all tests.

_____ It is to my advantage to ask questions when I do not understand something; indeed, it is my responsibility to seek out assistance from the professor if needed.

_____ I will respect the professors' office hours, and limit my questions regarding course material to those times.

_____ Tests cannot be made up except in documented cases of emergency (e.g., death of relative, etc.).

_____ Class begins exactly at 8:45 AM unless specifically noted otherwise. If I am late, I will be locked out until the break.

I have thoroughly read and understand the syllabus and the requirements for this course in their entirety.

Signature: _____ Date: _____

Print name: _____