

The Sleeping Brain (PSY414)

Tuesday/Thursday 1:00-2:15pm

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Drop-In Office Hours: Monday 10:00am-11:00am, Tuesday 2:30-3:30pm, or make an appointment

Course Description

“If sleep does not serve an absolutely vital function, then it is the biggest mistake the evolutionary process ever made.” - Allan Rechtschaffen¹

We spend about a third of our lives sleeping. But *why*? Surprisingly, we still don't know the answer to this question. In this course, we will read and discuss a variety of theories of the function of sleep, with a particular focus on *cognitive* functions of sleep and dreaming, including memory consolidation, problem-solving, creativity, and synaptic homeostasis. Readings blur the disciplinary boundaries of physiology, psychology, and neuroscience. In parallel with our discussions of the research literature, we will work together to conduct a study testing one theory of sleep function: that sleep is necessary for consolidating memory. The course will culminate as students complete a final paper addressing the question “why do we sleep?”, now armed with scientific evidence to support their developing views.

Course Objectives:

1. To explore and evaluate current theories of the function of sleep
2. To become more informed consumers of scientific literature in general
3. To understand current challenges in the practice of scientific research
4. To develop critical thinking skills as applied to interpreting scientific studies

Course Structure and Requirements

Format of the Class

The class meets twice a week. We will be splitting our time between reviewing and discussing scientific research (typically on Tuesday of each week), and working together on a research project (typically on Thursday of each week). Tuesday “Research Discussions” will consist of a structured student-led discussion of the assigned articles. You are expected to keep up on all the reading, so that you can participate productively in the weekly discussion and develop knowledge that informs your work on our research study. You will prepare for discussion through weekly writing assignments and required contributions to a Moodle-based discussion board. These discussions are the meat of the course. ***The quality of this class is determined by YOU, by how well prepared you are and how freely and honestly you are willing to discuss the readings, your own ideas, and the comments of others. Make it happen!***

During this course, students are expected to:

1. **Complete the assigned readings.** Each week we will complete readings from the scientific literature. Book chapters and review articles will also be used to provide some background on sleep research basics. All readings will be posted in Moodle. Many of these readings are difficult and will require a substantial investment of your time. Take notes, think deeply, and then read it again if necessary. For advice on tackling difficult scientific literature, refer to **“Erin’s Guide to Reading and Critiquing Scientific Articles” posted on Moodle.** (Yes, you may call me “Erin”, although I will also respond to “Dr. Wamsley” [pronounced: WOM-zlee]).

¹ Who is Allan Rechtschaffen? Find out: <http://www.sleepresearchsociety.org/conversationwithfounders.aspx>

2. **Participate in class discussions.** Good participation is more than just speaking in class. Come prepared with your questions, ideas, arguments, and thoughts, having completed the readings, and ready to discuss and to ask intelligent questions about what you didn't understand. Contribute your ideas by speaking up, but also be an attentive listener who considers and responds productively to the ideas of others. Ideally, your well-prepared contributions will decide the topic and direction of discussion for each day, rather than having this dictated by me. To facilitate this, you will be asked to bring a written list of possible discussion questions with you to class each Tuesday.
3. **Participate in the Moodle discussion board.** Every week, you will contribute at least two posts to the class discussion board on Moodle.
4. **Complete written critiques of the assigned research articles.** Each week, you will complete a brief writing assignment on the week's reading.
5. **Take your turn in introducing the weeks' reading and leading the class in discussion.**
6. In collaboration with other students and myself, throw your full effort into to **designing, conducting, and analyzing the results of a research study** testing the hypothesis that sleep functions to consolidate memory.
7. **Write a final paper** on a course topic of your choice.

Assignment Guidelines

Article Critiques

Each week, in preparation for our "Research Discussions", you will write a commentary that addresses the scientific research articles assigned for that day. In under 2 pages (double-spaced), the commentary should describe what you think are the main strengths and weaknesses of each research article. The critique does not need to include a summary of the research articles (I have read them too!)

In thinking about how to critique the strengths and weaknesses of a research article, you should refer to "**Erin's Guide to Reading and Critiquing Scientific Articles**", posted on Moodle. We will also discuss this in class. Your critiques can be written in an informal voice, but they should be thoughtful and well-organized, and importantly, your opinions about the strengths and weaknesses of the research must be supported by specific evidence. Be sure to use this opportunity to focus on writing about what YOU THINK of the readings, rather than just regurgitating information from what you read. **Responses are due the day before every Research Discussion class period (typically Mondays by midnight)**, and should be submitted via Moodle by clicking on the assignment upload link for that week. You will receive feedback from me on your critiques via Moodle. We may also discuss selected points from your responses in class. Grading criteria for Article Critiques is as follows:

Understanding of the Material (25%)

Does the student seem to understand the main points of the research article? Is the understanding at a sufficient level of depth and complexity? Or are they just regurgitating what they see in the abstract?

Critical Assessment (25%)

Does the student come up with thoughtful, original ideas about strengths and weaknesses of the papers that are specific to these articles? Or is the commentary overly-general or poorly thought out?

Argument (25%)

Is each point supported by evidence? Is this evidence clearly explained and clearly connected as support for the main points? Is the reasoning sound and well thought-out? Or are there unsupported claims and gaps in the reasoning?

Writing (25%)

Is the critique well-written in terms of style, clarity, voice, grammar and organization? Are the sources appropriately cited? Is the writing concise, skillfully including all of the necessary information in a brevity of space?

Moodle Discussion Board

Every week, you will contribute at least 2 posts to the class discussion board on Moodle. This board is a starting point for the discussions that will be continued in class, helping us to think about and prepare for in-class discussion ahead of time. Discussion board posts are due Monday night, prior to when we will discuss those articles the next day. Each week, one of your posts will be a list of discussion questions that you want to pose to the class. In at least one other post, you will respond to someone else's question or comment.

- **Posting questions about the week's readings.** Come up with a few thoughtful questions that would be useful for the class to discuss. What interested you in the reading that you would like the class to discuss further? Is there something you didn't understand about one or more of the articles? What are the strengths and weaknesses of the methods/results/discussion that you are writing about in your Article Critiques? How strong was the evidence that the article presented? Was the hypothesis supported? Is there anything controversial here, or a point on which you disagree with the authors? Did you learn something amazing? How? How does this inform our research project? Post at least one question for each of the readings we are discussing that week.
- **Responding to a question posted by someone else.** You may respond to discussion questions posted by Dr. Wamsley or by other class members. Write thoughtful responses and be sure to clearly explain your reasoning.
- **Responding to someone else's response.** You can also respond to someone else's answer by explaining why they are right and you agree with them, or by explaining (respectfully) why they are wrong and you disagree with them. Your post must ADD SOMETHING SUBSTANTIVE to the discussion. A simple "yes, I agree" is not sufficient.

Discussion board posts are graded on a simple 3-point scale:

2 points = The post was completed on time and with sufficient or outstanding effort. If a question, the question prompts other students to support their answer with reasons/an argument. If a response, the response includes both a stated position and reasons/an argument crafted in support of that position.

1 point = The post was completed on time, but shows either shows a lack of sufficient effort or does not meet the requirement for including or eliciting a reasoned argument. The post may be short and incomplete, show flaws in reasoning, a lack of thoughtfulness, or a lack of understanding basic concepts.

0 points = Assignment not completed, or not completed on time.

YOU MAY NOT COMPLETE YOUR DISCUSSION BOARD POSTS LATE. Your lowest grade in this category will be dropped, allowing you to miss up to 1 week and still receive a perfect discussion board grade. Note the closing times for each discussion board on Moodle. Posting always closes the night before we are schedule to discuss those readings in class.

Introducing Class Discussion

Each Tuesday, one student will be in charge of introducing the research articles and starting our class discussion. Here are some basic guidelines for these presentations:

1. **First, start us off with a very brief summary of what you took to be the main, most important point of each article.** Use your own words and please don't read straight from your notes. Importantly, don't try to summarize all of the information in the article. Assume that everyone has done the reading. This introduction should be more about you telling us what you thought the "take-home" message was. (It might be that we don't all agree on what the most important point was, and that's fine)
2. **Next, help the class raise questions about anything they were not able to understand.** First, address the class with your own confusions about the material, and then take similar "questions of clarification" from the class so everyone is at a similar level of understanding before a detailed discussion begins. What didn't you understand? Ask the class what they found difficult to understand? Dr. Wamsley will help answer these

questions of clarification before we move on.

3. **You will then facilitate further discussion** of the papers by soliciting possible discussion questions from the class, writing these on the board, and asking the class to decide which question(s) they want to spend the remaining class time on. The discussion questions that the class brainstorms will likely be those that were posted on Moodle, but could include other questions brainstormed on the spot.

Presentation dates will be assigned during the 1st week of the term. The first week, Erin will do this, to give you an example. Grading of these mini-presentations is based on your mastery of the material, preparation, oral communication skill, and ability to engage the class in an effective back-and-forth discussion that includes all class members.

Research Project

In this class, we will do more than just talk about research – we will be using this class as an opportunity to make a contribution to this research ourselves! Using our Thursday meeting times as a lab meeting, across the course of the semester, we will conduct our own new study testing one of the hypotheses that we are reading about in this seminar – that sleep functions to consolidate recent memory. The first few Thursdays, we will focus on brainstorming and designing the project, with later class periods providing in-class time to work together on data collection, analysis, and interpretation. More details on this project will be discussed later in the course, most of which will be determined by your input. **The ultimate goal is for us to do real science together**, creating something more enduring than "just a class project". But I can't guarantee that will happen – the success of the project will hinge on the level of your commitment and your ability to work as a functional research team with the rest of your classmates and myself (plus a bit of luck too).

Final Paper

Your final paper is an opportunity to read and think about a specific course topic that interests you in more detail, and to develop and defend your ideas on that topic. You may choose either to write an empirical report describing the results of our research study, or to write a literature review centered on a different course topic, in which you develop and defend an original thesis. More details about completing the paper will be provided later in the term. Regardless of the option you choose, **the paper will be due on the scheduled final exam day for this course, December 12th**. A proposed topic (title + one paragraph overview) and 3 references that you will discuss (original articles) will be due 4 weeks earlier.

Grading

You can see your course grades at any time by checking the gradebook on Moodle.

Assignments will contribute to your course grade as follows:

In-Class Participation (including presentations)	10% of final grade
Discussion Board Posts	10% of final grade (lowest score dropped)
Article Critiques	25% of final grade (lowest score dropped)
Participation in Research Project	25% of final grade
Final Paper	30% of final grade

Total = 100%

Letter grades are awarded as follows: A=94-100%, A-=90-93%, B+=87-89%, B=84-86%, B-=80-83%, C+=77-79%, C=74-76%, C-=70-73%, D+=67-69%, D=64-66%, D-=60-63%, F=<60%

Other Course Policies

Attendance

Class attendance is required. In this seminar course, in-class participation forms the core of the class experience. You may miss up to three class sessions without penalty to your grade. After this, each absence will deduct 1 percentage point from your participation grade for the course. There is no distinction between excused and unexcused absences, so it is important that you save your “allowed” absences for unavoidable situations. If you are an athlete who needs to travel to games or have other university-sanctioned planned absences, don't worry, you will not be penalized for this – but please come talk to me about it early in the semester.

Late Assignments

Turn in your work on time. If you need an extension on an assignment, talk to me about this *ahead of time*, and we can probably work it out. Late assignments that have not been discussed with me ahead of time will not receive full credit. But you should definitely still turn them in a.s.a.p.

Academic Honesty

You will be held accountable for understanding and following Furman University's academic honesty policies (see www.furman.edu/integrity and <http://policies.furman.edu/view.php?policy=584>). Written work is expected to be your own. Using information from other sources (like a journal article or the internet) without citing this information is plagiarism. If you plagiarize your work you will automatically receive a zero for that assignment. Serious or repeated cases of plagiarism will result in failure of the course. All cases of academic dishonesty will be reported to the Associate Academic Dean, and could result in further penalties at the University level. Additional information on plagiarism can be found at: <http://www.plagiarism.org/plagiarism-101>. If you have questions about how to properly cite your sources, ask! The course Moodle site also includes links to information about referencing the work of others.

What To Do If You Have a Problem

Talk to me!!! Email is great, but also be sure to take advantage of my drop-in office hours (listed above), or if you need/want to meet at a different time, email me for an appointment.

Course Schedule

Readings and other assignments are due on the day they are listed. All readings are posted on Moodle

Aug 22 Introduction to the Course (and each other)

Aug 24 Research Discussion: Sleep -- What is it?

- Moorcroft, W. (2013). Chapter 1: What is Sleep and How is it Scientifically Measured? In *Understanding Sleep and Dreaming*.
- Broughton et al. (1994). Homicidal somnambulism: A case report. *Sleep*.

Sleep and Memory Consolidation

Aug 29 Research Discussion: Sleep and Memory I -- Sleep Benefits Human Memory

- Plihal, W., and J. Born. (1997). Effects of Early and Late Nocturnal Sleep on Declarative and Procedural Memory. *Journal of Cognitive Neuroscience*.
- Ellenbogen, J. M, P. T Hu, J. D Payne, D. Titone, and M. P Walker. (2007). Human Relational Memory Requires Time and Sleep. *PNAS*.
- Dement, W. C., & Vaughan, C. C. (2000). The Promise of Sleep. Chapter 2.

Aug 31 First Project Meeting

Sept 5 Research Discussion: Sleep and Memory II -- Memory Reactivation

- Lee & Wilson, (2002). Memory of sequential experience in the hippocampus during slow wave sleep. *Neuron*.
- O'Neill, J., Pleydell-Bouverie, B., Dupret, D., & Csicsvari, J. (2010). Play it again: reactivation of waking experience and memory. *Trends in Neurosciences*.
- Dement, W. C., & Vaughan, C. C. (2000). The Promise of Sleep. Chapter 4.

Sept 7 Project Meeting: Brainstorming Ideas for the Research Study

Sept 12 Research Discussion: Sleep and Memory III -- Dreaming and Memory

- Wamsley, E. J. (2014). Dreaming and Offline Memory Consolidation. *Current Neurology and Neuroscience Reports*.
- Wamsley, E. J., Tucker, M. A., Payne, J. D., Benavides, J. A., & Stickgold, R. (2010). Dreaming of a learning task is associated with enhanced sleep-dependent memory consolidation. *Current Biology*.
- Dement, W. C., & Vaughan, C. C. (2000). The Promise of Sleep. Chapter 10.

Sept 14 Project Meeting: Finalizing the Study Design

Research Goal: Submit the IRB Proposal by This Weekend

Other Biological Functions of Sleep

Sept 19 Research Discussion: Is there an Unknown Biological Function for Sleep?

- Everson, C. A., Bergmann, B. M., & Rechtschaffen, A. (1989). Sleep deprivation in the rat: III. Total sleep deprivation. *Sleep*.

Sept 21 Project Meeting: Preparing for Data Collection

Sept 26 Research Discussion: Sleep and Synaptic Homeostasis I

- Tononi, G. & Cirelli, C. (2006). Sleep function and synaptic homeostasis. *Sleep Medicine Reviews*.
- Huber, R., Ghilardi, M. F., Massimini, M., & Tononi, G. (2004). Local sleep and learning. *Nature*, 430(6995), 78.

Sept 28 Project Meeting: Preparing for Data Collection

Oct 3 Research Discussion: Sleep and Synaptic Homeostasis II

- De Vivo, L., Bellesi, M., Marshall, W., Bushong, E. A., Ellisman, M. H., Tononi, G., & Cirelli, C. (2017). Ultrastructural evidence for synaptic scaling across the wake/sleep cycle. *Science*, 355(6324), 507-510.
- Frank, M. G. (2012). Erasing Synapses in Sleep: Is It Time to Be SHY? *Neural Plasticity*, 2012, 1–15.

Oct 5 Project Meeting: Data Collection

Oct 12 Project Meeting: Data Collection

Oct 17 Research Discussion: Sleep and Immune Function

- Bryant, P. A., Trinder, J., & Curtis, N. (2004). Sick and tired: does sleep have a vital role in the immune system?. *Nature reviews. Immunology*, 4(6), 457.
- Cohen, S., Doyle, W.J., Alper, C., et al. (2009). Sleep habits and susceptibility to the common cold. *Arch Intern Med*, 169(1):62-67.

Oct 19 Project Meeting: Data Collection

Oct 24 Research Discussion: Sleep Washes Your Brain? Seriously?

- Xie et al. (2013). Sleep drives metabolite clearance from the adult brain. *Science*.
+Commentary:
Herculano-Houzel, Suzana. (2013). Sleep It out. *Science*.

Other Psychological Functions of Sleep

Oct 26 Project Meeting: Data Collection

Research Goal: Complete Data Collection by This Week

Oct 31 Research Discussion: Sleep and Creativity

- Cai, D., et al. (2009). REM, not incubation, improves creativity by priming associative networks. *PNAS*.
- Ritter, S.M., et al. (2012). Good morning creativity: task reactivation during sleep enhances beneficial effect of sleep on creative performance. *Journal of Sleep Research*.

Nov 2 Project Meeting: Finalizing Data Analysis Plan

Nov 7 Research Discussion: Dreaming as Wish Fulfillment (or not)?

- Freud (1900). *The interpretation of dreams*. Chapters 2-4.
- Chapter 9 from Allan Hobson's *The Dreaming Brain*.

Nov 9 Project Meeting: Data Analysis

Nov14 Research Discussion: Sleep, Dreaming, and Emotion

- Payne et al., (2008). Sleep preferentially enhances memory for emotional components of scenes. *Psychological Science*.
- Gujar, N., et al. (2011). A role for REM sleep in recalibrating the sensitivity of the human brain to specific emotions. *Cerebral Cortex*.

****Final Paper Topic Proposal Due**

Nov16 Project Meeting: Data Analysis

Research Goal: Complete Analysis by This Week

Nov21 Research Discussion: Sleep and Problem Solving

- Wagner et al., (2004). Sleep inspires insight. *Nature*.
- Beijamini, F., Pereira, S. I. R., Cini, F. A., & Louzada, F. M. (2014). After Being Challenged by a Video Game Problem, Sleep Increases the Chance to Solve It. *PLoS ONE*.

Nov28 Research Discussion: The Future of Sleep Research

- Horikawa, T., et al. (2013). Neural decoding of visual imagery during sleep. *Science*.
- Bendor, D. & Wilson, M. (2012). Biasing the content of hippocampal replay during sleep. *Nature Neuroscience*.

Dec 30 Project Meeting: Writing and Analysis Workshop

Dec 5 Final Paper Peer-Review Workshop

****Complete Draft of Final Paper Due (noon)**

Research Goal: Publish in *Science*

FINAL PAPER DUE BY DECEMBER 12 at The Stroke of Midnight