## COGS 1: Winter 2020
### Section B, Week 3

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Availability</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor Boyle</td>
<td><a href="mailto:mboyle@ucsd.edu">mboyle@ucsd.edu</a></td>
<td>Friday, 2-4 pm</td>
<td>CSB 130</td>
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<tr>
<td>Tiffany</td>
<td><a href="mailto:tchokry@ucsd.edu">tchokry@ucsd.edu</a></td>
<td>Tuesday, 12-1 pm</td>
<td>CSB 114</td>
</tr>
<tr>
<td>Bora</td>
<td><a href="mailto:bmutluog@ucsd.edu">bmutluog@ucsd.edu</a></td>
<td>Wednesday 4-5 pm</td>
<td>PC Jamba Juice</td>
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<tr>
<td>Jon</td>
<td><a href="mailto:jahern@ucsd.edu">jahern@ucsd.edu</a></td>
<td>Tuesday, 2-3pm</td>
<td>CSB 114</td>
</tr>
<tr>
<td>Bryan</td>
<td><a href="mailto:blt010@ucsd.edu">blt010@ucsd.edu</a></td>
<td>Thursday, 1-2pm</td>
<td>Sequoyah 142</td>
</tr>
<tr>
<td>Corey</td>
<td><a href="mailto:yiz329@ucsd.edu">yiz329@ucsd.edu</a></td>
<td>Wednesday, 1-2pm</td>
<td>CSB 231</td>
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<tr>
<td>Meri</td>
<td><a href="mailto:myedigar@ucsd.edu">myedigar@ucsd.edu</a></td>
<td>Tuesday, 12:30 - 1:30 pm</td>
<td>PC 4th Floor</td>
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<tr>
<td>Ilmaa</td>
<td><a href="mailto:ilhaque@ucsd.edu">ilhaque@ucsd.edu</a></td>
<td>Tuesday, 2-3:30pm</td>
<td>PC Theatre</td>
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<tr>
<td>Ana</td>
<td><a href="mailto:achkhaid@ucsd.edu">achkhaid@ucsd.edu</a></td>
<td>Wednesday, 12-1pm</td>
<td>CSB 215</td>
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Important Information

• Review Questions
  ○ Available at the end of every week on Saturday
  ○ Use these to guide your understanding of lecture and readings

• Extra Credit
  ○ EC quizzes on readings on Canvas
    • Opens Wed 4pm and closes Thu 10am before lecture

• Section Slides
  ○ Posted after the end of the last section on Friday
Last Week’s Topics

- Lecture 3 | Dr. Boyle: Sleep and Alzheimer's disease
- Lecture 4 | Dr. Boyle: The Sleep Circuits
Review Questions (1 of 3)

1. What is the importance of blue light?
2. What is a well-being score? How does sleep affect it?
3. What are the stages of sleep and what happens during each stage?
4. How are sleep and Alzheimer’s Disease related?
5. What happens to our sleep as we age?
6. What is Beta Amyloid? What are the types of beta amyloid? What is Beta Amyloid Precursor? What does it do?
Review Questions (2 of 3)

7. How do neurons work?
8. What are the lobes of the brain?
9. Where are the primary sensory and motor cortices? What do they do?
10. What is the hippocampus?
11. What is the hypothalamus?
12. What is the thalamus?
13. What is the pons?
14. What is the corpus callosum?
15. What is CSF and how does it relate to the glymphatic system?
16. What neurotransmitters are associated with the sleep and arousal system?
17. What are the two different arousal systems? Where do they project?
18. What is ATP and how does it work?
19. What is caffeine and how does it affect the brain.
The Importance of Blue Light

- Short-wavelength light AKA blue light is interpreted by our circadian systems as daylight.
- Blue light is emitted by televisions, computers, phones, etc.
  - Postpones the signal to brain to go to sleep
  - Subsequently affects the release of melatonin
Well-Being Score & Sleep

5 Elements of Well-Being

- Purpose
- Social
- Financial
- Community
- Physical Activity

Number of hours of sleep can affect one’s well-being
Stages of Sleep

- REM and NREM sleep
- Delta waves in stage 4 (deep sleep) cause cleaning of plaque build up
  - Stage 4 is the most important for healthy brain function
Sleep and Alzheimer’s Disease

- Sleep dysfunction leads to abnormal accumulation of amyloid beta
- Deep sleep serves to “clean” the brain, and washes out the buildup of amyloid beta
- Accumulation of amyloid beta is linked to Alzheimer’s disease
What happens to our sleep as we age?

As you get older, you experience changes in sleep habit such as:

1. Increased sleep fragmentation
2. Night time awakenings
3. Increased day time sleep

The older you are, the worst your sleep habit is.
What is Beta Amyloid? What are the types of beta amyloid?

**APP - amyloid precursor protein**

**Beta amyloid (a.k.a. amyloid beta & Aβ) - fragment of APP**
How do neurons work?
What are the lobes of the brain?

- **Frontal Lobe:** Executive functions, thinking, planning and problem solving
- **Parietal Lobe:** Perception, making sense of the world (logic)
- **Occipital Lobe:** Visual processing area
- **Temporal Lobe:** Memory, understanding, language, auditory function
Primary sensory and Motor cortices

- Neurons in the Primary Motor Cortex control voluntary movements
- Neurons in the Primary Sensory Cortex receive information from afferent neurons that detect pain, pressure, touch, position of your body
What is the hippocampus?

- The hippocampus is a brain structure found in the temporal lobe.
- Hippocampus plays critical role in memory, emotion, and autonomic nervous system.
What is Hypothalamus?

- The hypothalamus is a small but important area that is located in the center of the brain.
- Hypothalamus a crucial role in many important functions including releasing hormones, regulating body temperatures, etc.
What is the thalamus?

- Receives and relays motor and sensory input to the cerebral cortex (Motor Control, Visual, Somatosensory, Auditory Signals)
- Regulates **sleep, consciousness, and alertness**
What is the pons?

- Regulates control of breathing, communication between parts of the brain, and involved in sensations such as hearing, taste, and balance
What is the corpus callosum?

- Connects the right side of the brain to the left and lets them communicate with one another
- Some brain processes are contralateral, so the corpus callosum aids in this
What is CSF and how does it relate to the glymphatic system? (1 of 2)

Brain removes toxic metabolic waste (including beta amyloid) using the cerebrospinal fluid in the glymphatic system
What is CSF and how does it relate to the glymphatic system? (2 of 2)
What neurotransmitters are associated with the sleep and arousal system?

- Adenosine
  - VLPO is sleep activated;
  - Builds up during wakefulness due to dephosphorylation, large amounts puts you to sleep
- Norepinephrine
  - REM-suppressive; Used in 2nd arousal system
- Acetylcholine
  - Activates various brain regions; REM-generating; Used in 1st arousal system
- Orexin
  - Excitatory to arousal system; loss causes narcolepsy
What are the two different arousal systems? Where do they project? (1 of 2)

1st arousal system:

- Acetylcholine
- Thalamus - gate to alertness; activated by ACh neurons in brainstem
- Fire fastest during awake states and REM sleep
What are the two different arousal systems? Where do they project? (2 of 2)

2nd arousal system:
- Norepinephrine (a.k.a. noradrenaline)
- Most active during awake states
- Lesions => profound sleepiness or even coma
- Inhibits VLPO when active
What is ATP and how does it work?

• Working and thinking requires energy -> Dephosphorylation of ATP
• Eventually dephosphorylates to Adenosine, which is a signal for sleep in the brain
• Signals the VLPO
What is caffeine and how does it affect the brain?

- VLPO promotes sleep and is active during it;
- Inhibits the arousal system;
- VLPO lesions lead to insomnia;
- Use of energy by the brain during wakefulness leads to production of adenosine;
- Adenosine binds to VLPO making you sleepy; caffeine interferes with this process;
- During sleep adenosine levels decrease.

Quiz Time
Quiz Time!

- No talking, signaling, or communicating of any kind.
- Put away your books, notes, computers, phones, etc.
- Pen or pencil is okay (just make sure it’s a black pen and you press hard with a pencil).
- Write your name in the “Name” box, write and circle in your PID, and sign the academic integrity agreement.
- Bubble in this section
- Please have your student ID out when you turn in your quiz!
Write and circle in your PID

Write down your name here

Bubble in the current section

Sign and date here

Bubble in the answers