

Spring Semester -- 2006  
University of Pennsylvania

# ***BiBB 340 -- Human Sleep and Chronobiology***

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**Teaching Assistant:**

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**Class Time and Location:**

Thursdays (1:30pm - 4:30pm). Classes will be held in the *John Morgan Building (Class of 1962 Auditorium)* or the *Biological Research Building (BRB Auditorium)*, in the School of Medicine (*see schedule below*). Please note that neither food nor drinks are permitted in the room and you should not leave newspapers and trash after class. Permission must be obtained from Prof. Dinges to tape record lectures.

**Office Hours:**

Daniel Mollicone will be available each Tuesday between 13:00 and 15:00 or by appointment (send email request).

**Course Performance Criteria:**

- You must attend and participate in all classes (unless you have an excused absence submitted in writing to Daniel Mollicone). ***Participation includes taking notes, staying awake, and volunteering to respond to questions and engage in discussion.*** Each class is worth 1% of your final grade (14% in total).
- You must pass two exams (a midterm and a final). Each exam is worth 40% of your final grade. The midterm covers primarily chronobiology and circadian rhythms, while the final is primarily on sleep, sleep deprivation, and sleep disorders.
- You must complete and present an independent project. The independent project is worth 6% of your final grade. For your independent project you are required to observe and document an example of material presented in the course. You may choose one of the following themes for your project.
  - i. an example of chronobiology or a circadian rhythm in nature
  - ii. an example of sleep in nature and/or society
  - iii. an example of the effects of sleep deprivation
  - iv. an example of a sleep disorder (symptoms or treatments)

Your documentation may take the form of a brief video (no more than 1 minute), sound recording (no more than 1 minute), photographs (no more than 5), news media report (1 minute limit), federal reports, etc. Do not use material from a scientific or medical article.

You will be required to make a 1-minute presentation of your independent project on either February 9th or March 30th during a time slot that will be assigned to you (random selection). There will be no trading of time slots without permission.

All presentation material must be imbedded in a Microsoft Power Point (.ppt) file and submitted on CD at the start of class on the day your presentation is scheduled.

Any photo, video, etc. that identifies another person (face and/or name) must not be presented without the express permission of that person.

The submitted CD will not be returned to you. The CD must (electronically) contain your name and the date and the course number ("BiBB 340") on the first slide, and this information must be written on the CD itself in bold marker.

Your independent projects will be evaluated and assigned an "all or nothing" score toward your final grade for the course of either 6% or 0%. Inadequate submissions (lacking any serious thought and effort) will receive a score of 0%.

Be creative!

**Organization of 3-hr Class Period:** Class begins promptly at 1:30 pm.

Lecture/discussion	55 minutes	(1:30-2:25 pm)
Break	10 minutes	(2:25-2:35 pm)
Lecture/discussion	55 minutes	(2:35-3:30 pm)
Break	10 minutes	(3:30-3:40 pm)
Lecture/discussion	50 minutes	(3:40-4:30 pm)

**Course Materials:**

1. Basics of Sleep, Sleep Research Society, Westchester, IL, 2005 (available at the bookstore).
2. Your class notes on the lectures.
3. Additional materials that will be distributed to you in class.

**Class and Date:**

**1 -- Jan. 12<sup>th</sup> Taking Responsibility; Thinking Parsimoniously.**  
**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content**

- Resolving issues of enrollment and attendance.
- Discussing course organization and student responsibilities.
- Distribution of Syllabus -- Q and A on syllabus.
- NOVA video "Secrets of the Psychics" (1 hour) -- What are three major points of video?
- Discovery Channel video "If We Had No Moon" (1 hour) -- What are three major points of video?

**2 -- Jan. 19<sup>th</sup> Origins, Measurements and Meanings of Biological Rhythmicity.**  
**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Discussion of course structure, materials, and content.
- Discussion of "Secrets of the Psychics."
- The astrophysical basis for endogenous biological rhythms.
- What is a photoperiod? What is Philadelphia's photoperiod on Jan. 20, 2005?
- Humans on Mars--Earth-based endogenous rhythms in Martian orbital mechanics.
- Discussion of biological rhythms & sleep -- Are humans unique among animals?
- What do plants and people have in common?
- Some historical firsts in establishing endogenous biological rhythmicity.
- Two processes (endogenous circadian pacemaker & homeostatic drive for sleep).
- Chronobiological paradigm compared to the homeostatic paradigm.
- What are the functions of biological rhythms?
- What kinds of rhythmic processes are found in humans?
- What are biorhythms versus biological rhythms?
- How are biological rhythms measured?
- What are circadian, ultradian, and infradian rhythms?

**3 -- Jan. 26<sup>th</sup> Organization of Circadian Pacemaker, Inputs and Outputs.**

**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Characteristics, organization, and neural basis of endogenous rhythms.
- Suprachiasmatic nucleus: A cellular/molecular circadian clock.
- Measuring entraining inputs; endogenous rhythmicity, and oscillator outputs:
  - zeitgebers
  - phase response curves
  - retinohypothalamic tract
  - double raster plots
  - endogenous rhythmicity and tau
  - rest-activity cycles
  - masking
  - core body temperature
  - phase relationships and external desynchrony
  - endogenous melatonin secretion

**4 -- Feb. 2<sup>rd</sup> Human Circadian Rhythms: Physiological systems, hormones, sleep.**

**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Experimental paradigms for establishing the presence and relative influence of endogenous circadian rhythmicity:
  - free-run and spontaneous internal desynchrony
  - ultradian days
  - disentrainment
  - forced desynchrony
  - constant routine and sleep deprivation
- Circadian control of neuroendocrine rhythms:
  - melatonin
  - thyroid hormones
  - cortisol
  - growth hormone
- Circadian control of sleep physiology:
  - sleep onset, sleep duration, REM sleep, non-REM sleep

**5 -- Feb. 9<sup>th</sup> Independent project demonstrations by students 1 - 52**

**Location: NOTE CHANGE OF CLASSROOM -- Biological Research Building (BRB Auditorium)**

**6 -- Feb. 16<sup>th</sup> Human Circadian Rhythms: Alertness and Accidents.**

**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Circadian control of sleepiness and alertness -- methodological issues.
- Circadian control of neurobehavioral performance: What aspects of cognitive performance are affected?
- Two-process model and biomathematical models of fatigue.
- A biphasic sleep propensity rhythm -- the case for siesta.
- Temporal profile of fatigue-related accidents.
- Shift work and night work.
- Jet lag.
- Delayed sleep phase syndrome.
- Circadian control of mood.
- Seasonal affective disorder.
- Occupational, safety, and public policy implications of circadian influences on human performance and safety.

**7 -- Feb. 23<sup>rd</sup> Sleep Phenomenology -- From Phylogeny to Ontogeny.**

**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Sleep: Behavioral and electrophysiological definitions.
- How do you know whether/when an organism is sleeping?
- Sleep and evolutionary.
- The increasing hypersynchrony of nonREM sleep.
- Waking versus REM sleep, versus nonREM sleep: Physiology and behavior.
- Developmental changes in sleep across the lifespan.
- Review for midterm exam.

- Sleep disorders. Nature Neuroscience Supplement, 5: 1071-1075, November 2002.

**8 -- March 2<sup>nd</sup> Midterm exam on chronobiology.**  
**Location: John Morgan Building (Class of 1962 Auditorium)**

**March 9<sup>th</sup> SPRING BREAK**

**9 -- March 16<sup>th</sup> Neurobiology of Sleep and Waking -- What keeps us awake? What puts us to sleep?**  
**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Ascending reticular activation.
- Basal forebrain -- nucleus of the solitary tract.
- Ventrolateral preoptic area (VLPO).
- Aminergic brainstem nuclei (TMN, LC, DR, PT)
- Wakefulness: Dopamine, CRF, TRF, VIP, histamine, serotonin, noradrenaline.
- REM sleep: Acetylcholine.
- NREM sleep: GABA.
- Adenosine.
- Growth factors and immune neuropeptides.
- Benzodiazepines and newer hypnotics.
- Caffeine, amphetamine and modafinil.

**10 -- March 23<sup>th</sup> Functions of Waking ... of Sleep ... of REM ... of Dreams? (Part 1)**  
**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Sleep propensity as measured by sleep latency tests.
- Sleepiness and its neurobehavioral consequences.
- Sleep deprivation and sleep debt.
- Wake state instability.
- Drowsy driving.
- Sleepiness countermeasures.
- Physiological correlates of severe sleep deprivation (disk-over-water paradigm).
- Sleep and mentation: From hypnagogic reverie to dreams to sleep inertia to dreaming awake.

**11 -- March 30<sup>th</sup> Independent project demonstrations by students 53 – 104**  
**Location: John Morgan Building (Class of 1962 Auditorium)**

**12 -- April 6<sup>th</sup> Functions of Waking ... of Sleep ... of REM ... of Dreams? (Part 2)**  
**Location: John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Sleep propensity as measured by sleep latency tests.
- Sleepiness and its neurobehavioral consequences.
- Sleep deprivation and sleep debt.
- Wake state instability.
- Drowsy driving.
- Sleepiness countermeasures.
- Physiological correlates of severe sleep deprivation (disk-over-water paradigm).
- Sleep and mentation: From hypnagogic reverie to dreams to sleep inertia to dreaming awake.

**13 -- April 13<sup>th</sup>    Sleep Disorders -- Diagnosis and Treatment. (Part 1)**  
**Location:        John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Narcolepsy.
- Obstructive sleep apnea syndrome (and central apnea).
- Restless Legs Syndrome.
- Periodic Limb Movements.
- Disorders of arousal (parasomnias).

**14 -- April 20<sup>st</sup>    Sleep Disorders -- Diagnosis and Treatment. (Part 2)**  
**Location:        John Morgan Building (Class of 1962 Auditorium)**

**Content:**

- Disorders of Sleep-Wake Schedule.
- Insomnia and its many causes and treatments.
- Sleep and psychiatric disorders.
- Sleep loss from other medical conditions.

**Review for final exam.**

**FINAL EXAM**

**Date: TO BE ANNOUNCED**

**Location: TO BE ANNOUNCED**