

Mary Ellen Wells, PhD, RPSGT, R. EEG  
T., R. NCS T.

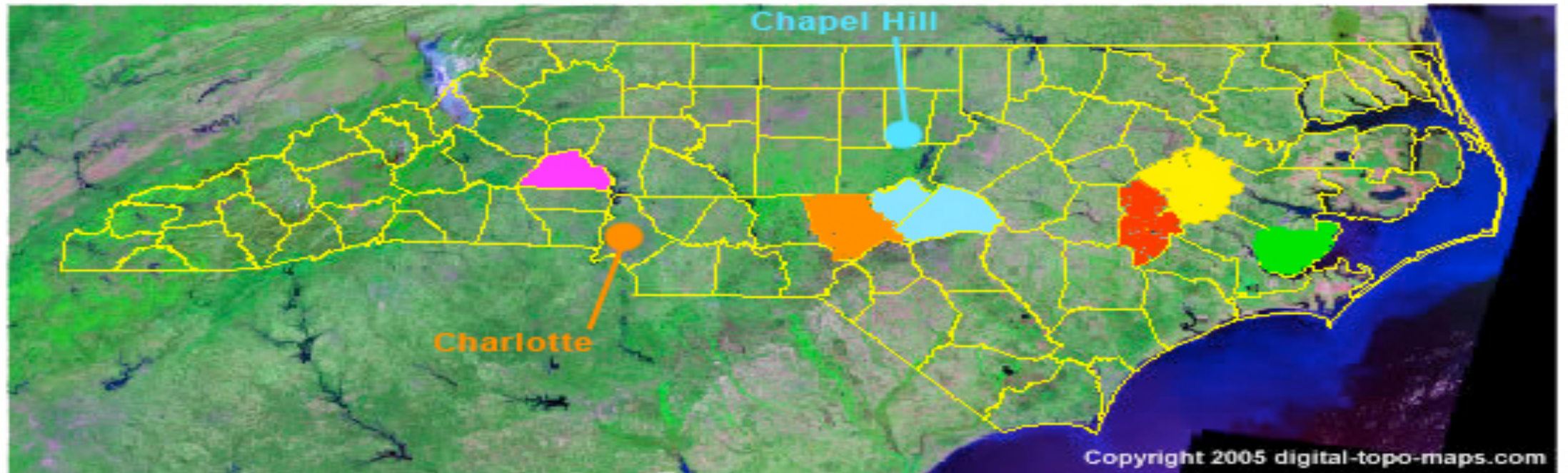
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Funding: The Eddie and Jo Allison Smith Family Foundation



<https://tinyurl.com/UNCsmithfamilysleep>

# NC Leads in Sleep Education



■ Catawba CC (2 programs)  
■ Sandhills CC  
■ Central Carolina CC

■ Lenoir CC  
■ Pamlico CC  
■ Pitt CC



# Neurodiagnostics and Sleep Science BS Program... and future MS program

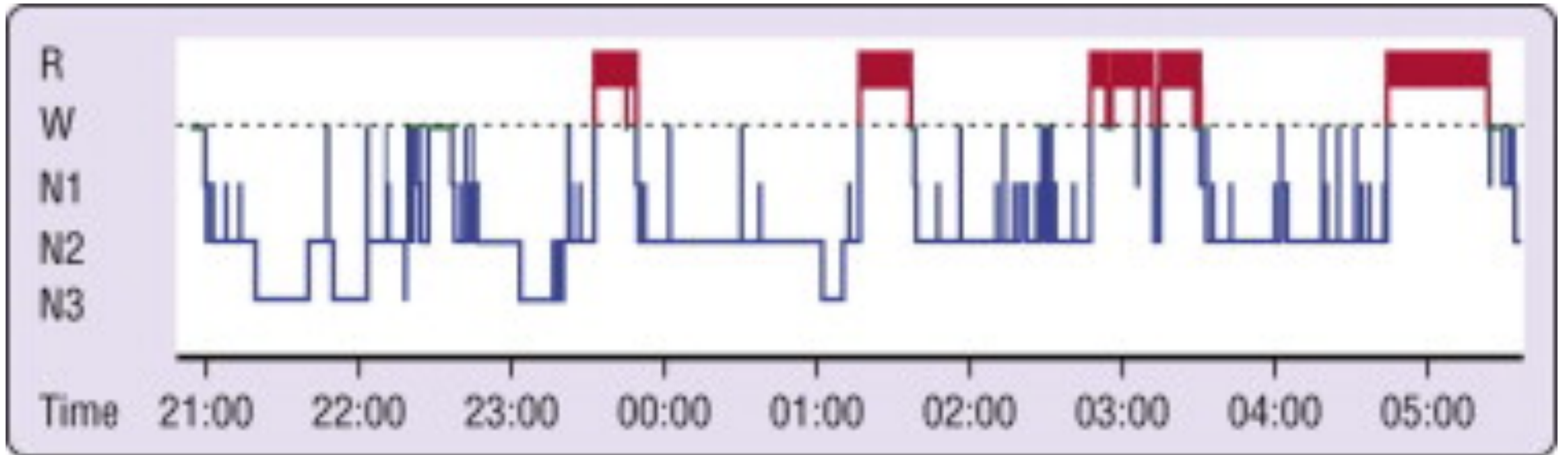


Left to right: Bradley Vaughn, Mary Ellen Wells, Eric D'Amico, Ashley Hastings, Regina Arocha, Kristy Mackell, Amber Fleming, Deborah Panza, Eunmi Han, Auburne Hutchins, Scott Gordon, and Stephen Hooper

# Sleep Research Methods and Tools



# Sleep-Wake Cycle



Normal sleep hypnogram (Keenan & Hirshkowitz, 2011)

# Objective Measures

## Polysomnography

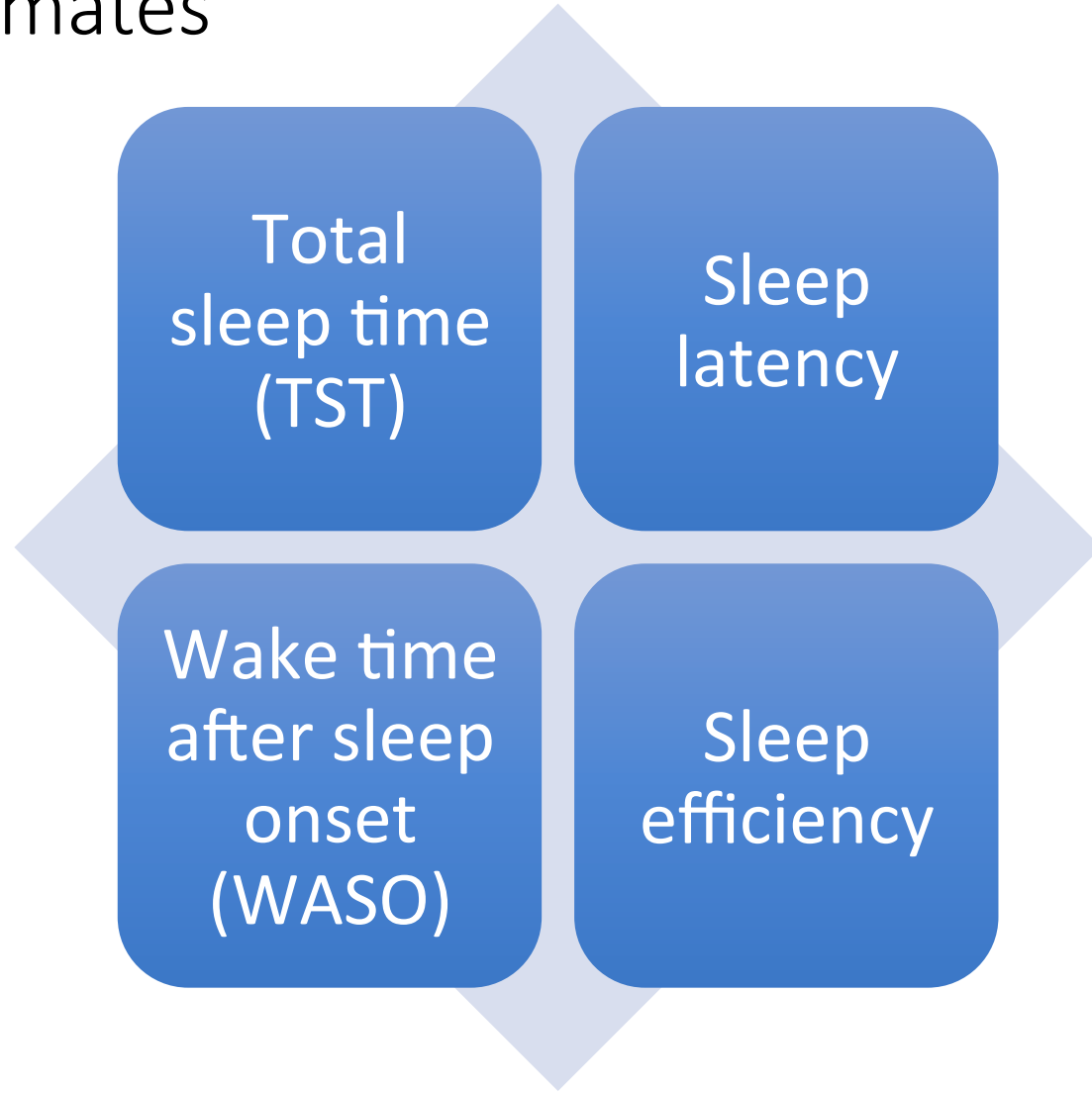


## Actigraphy





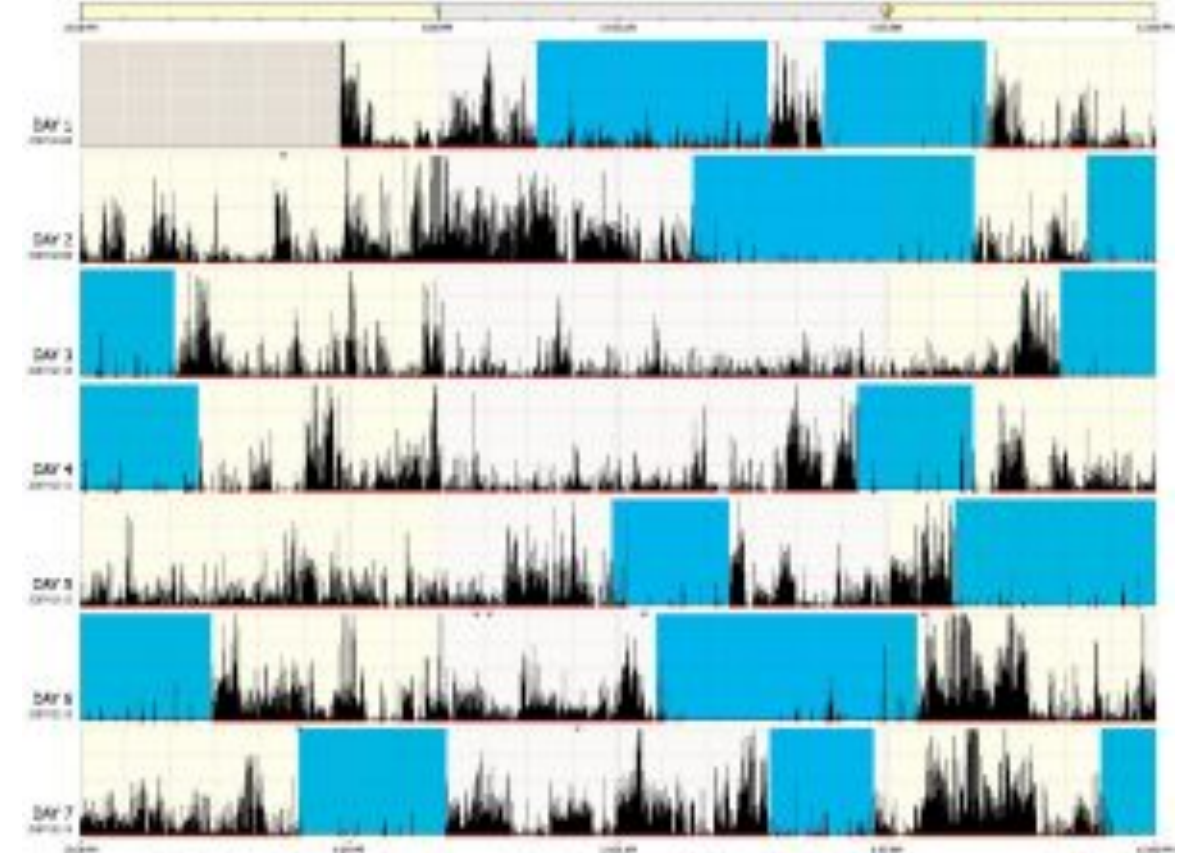
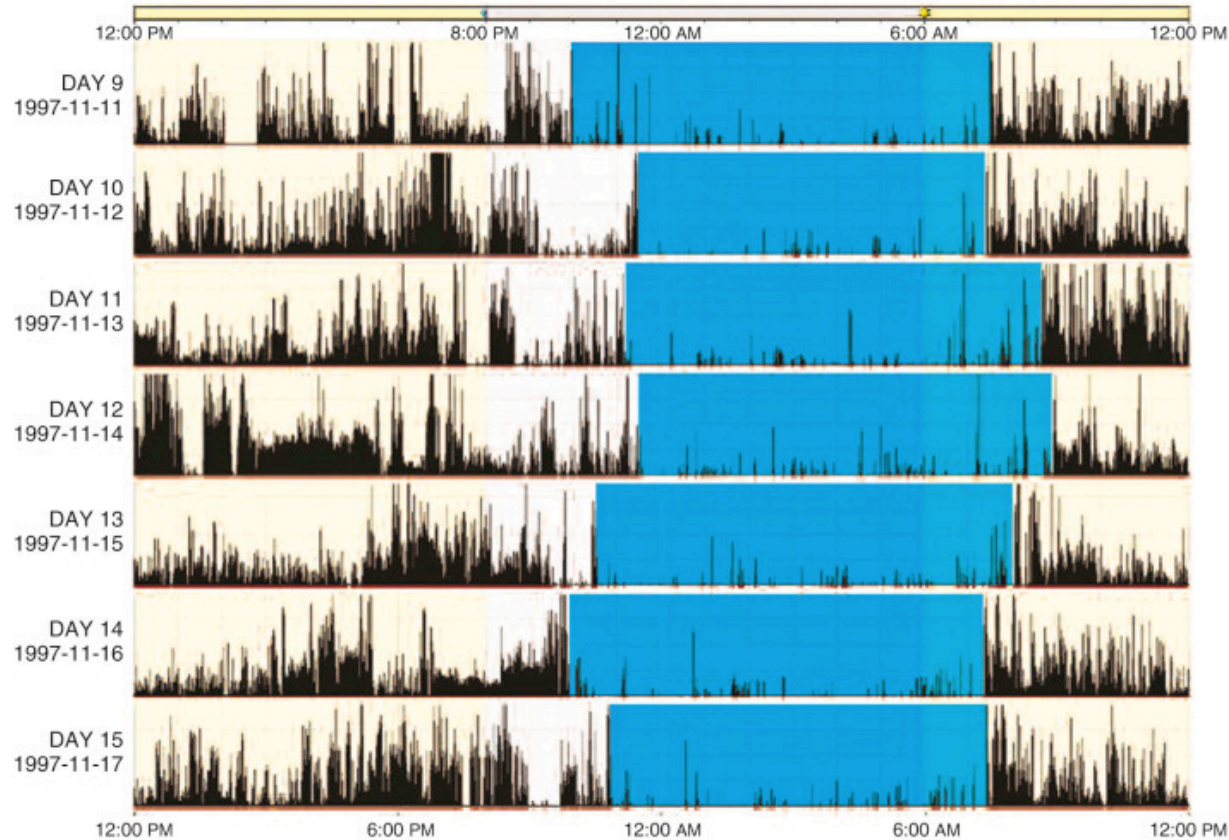
# Actigraphy Estimates



- Valid and reliable (according to the AASM) in normal healthy adults
- Use in conjunction with a sleep diary



# Normal Actigraphy Recording

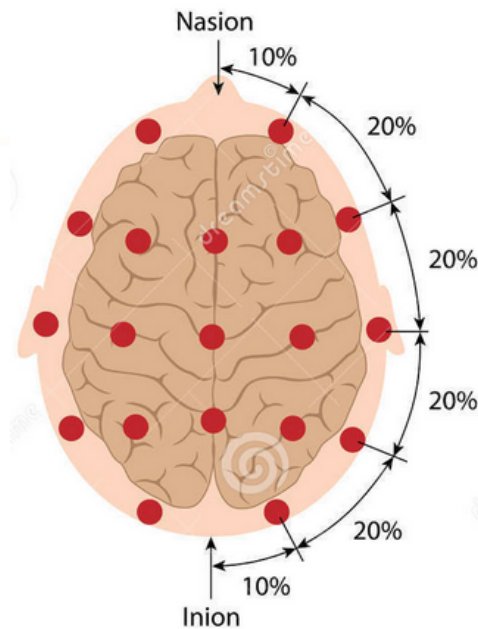
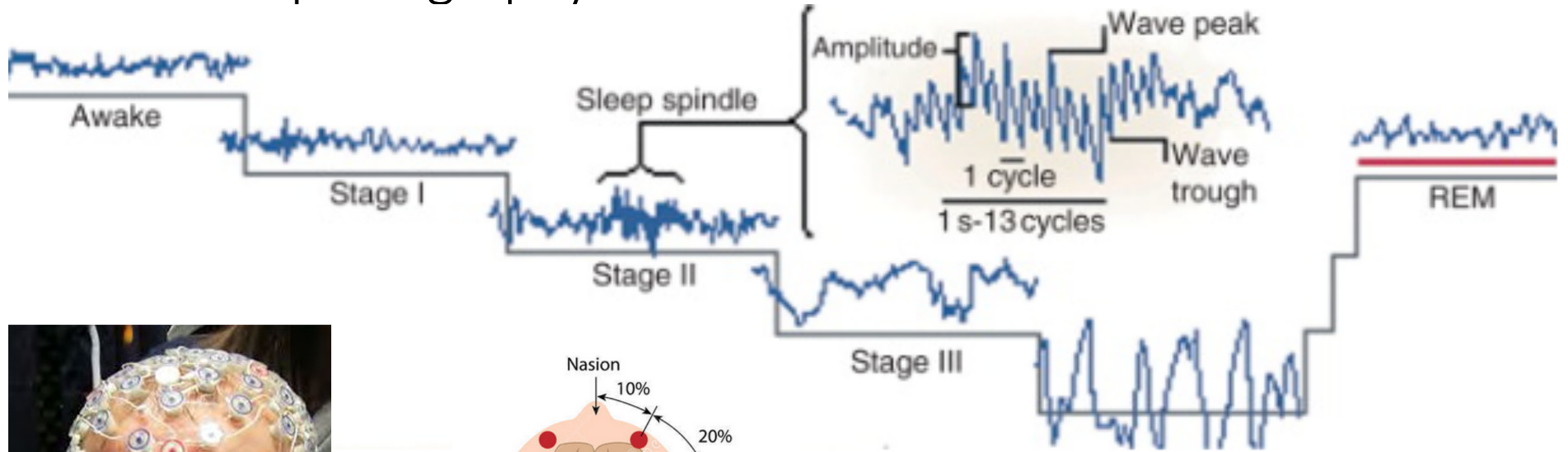


Insomnia

# Actigraphy Devices



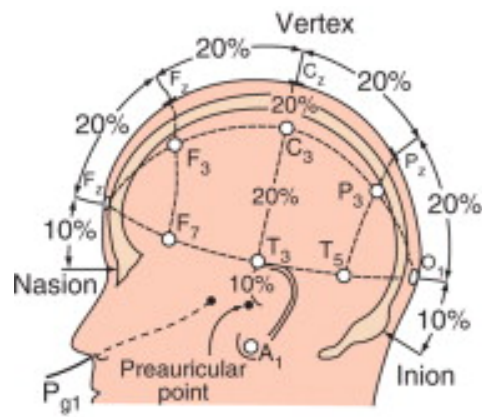
# Electroencephalography



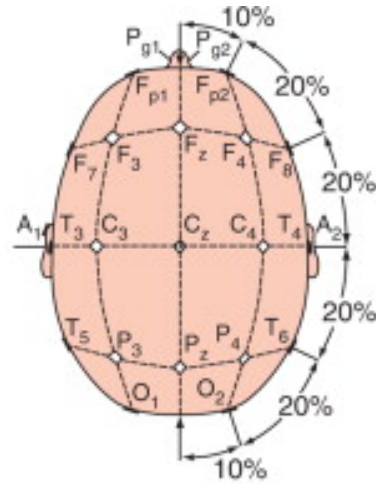
EEG in the different sleep stages (Pace-Schott, 2009)



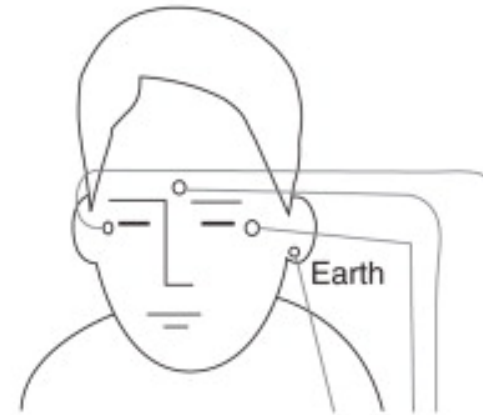
# Polysomnography



EEG



EOG



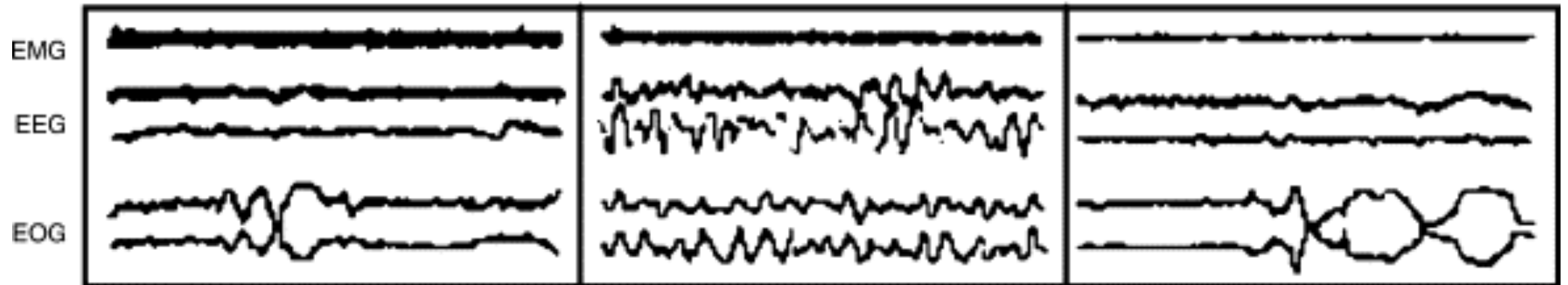
EMG



WAKE

NREM

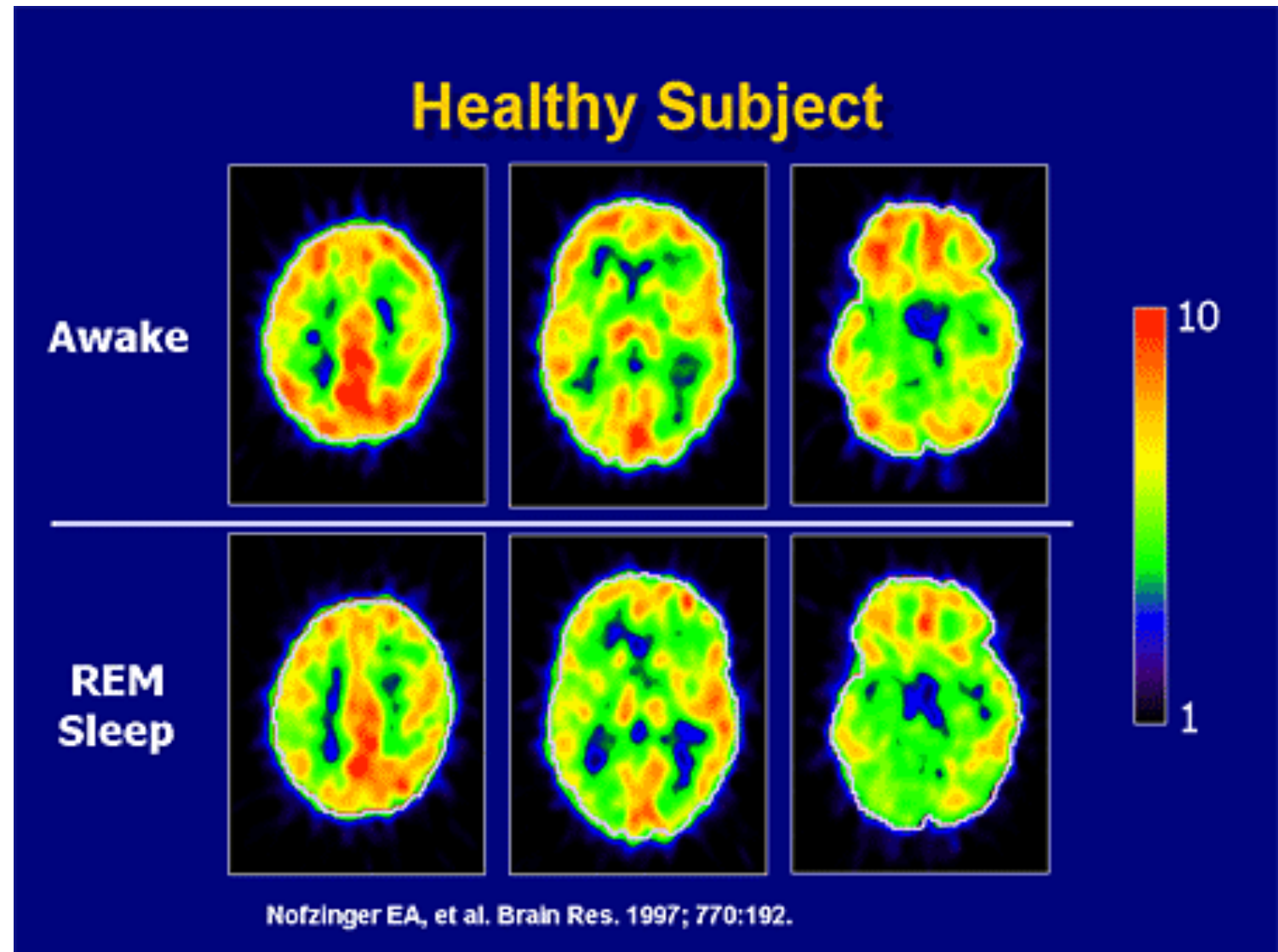
REM



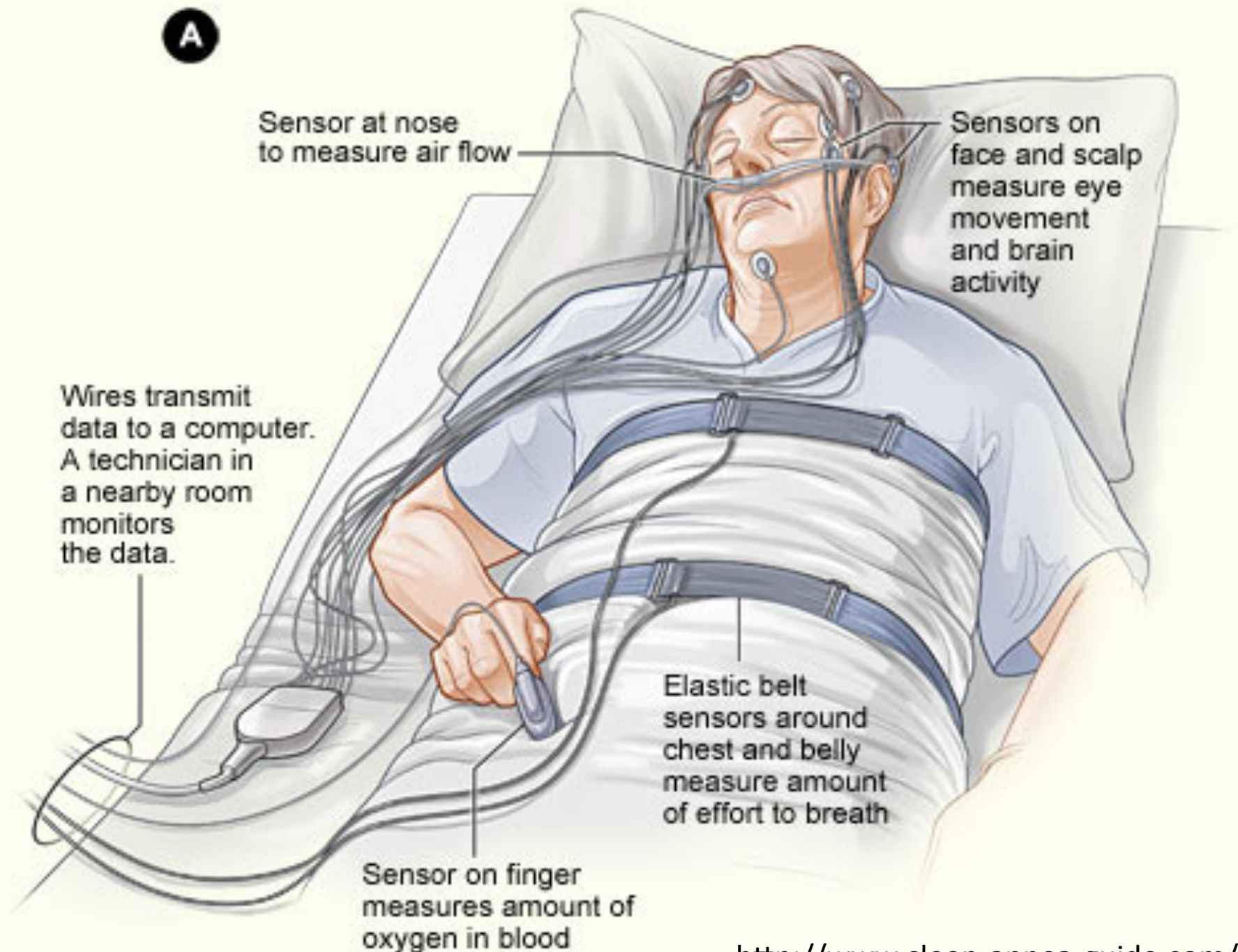


# Brain Imaging

- PET
- fMRI



A



# Body and Brain Temperature

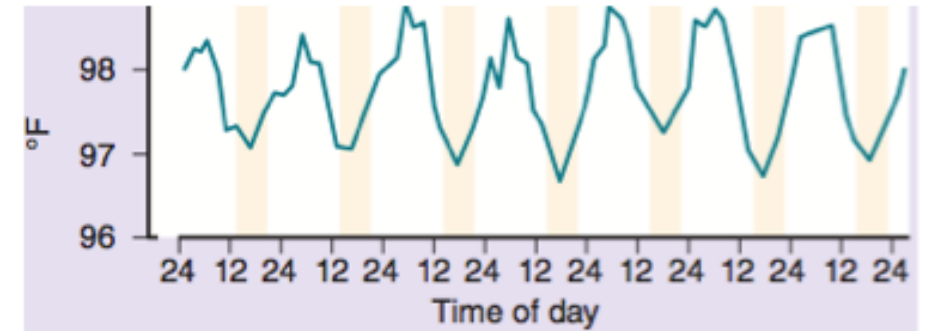
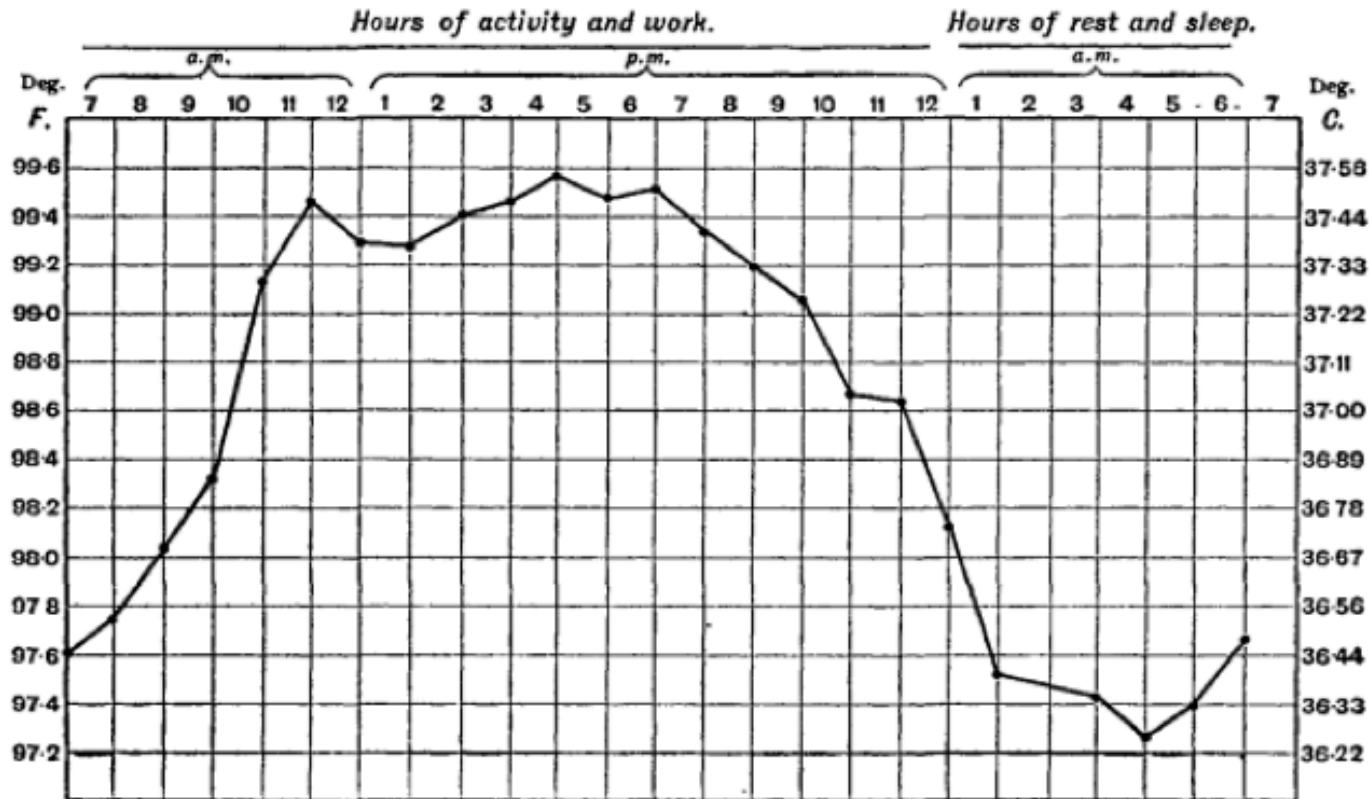
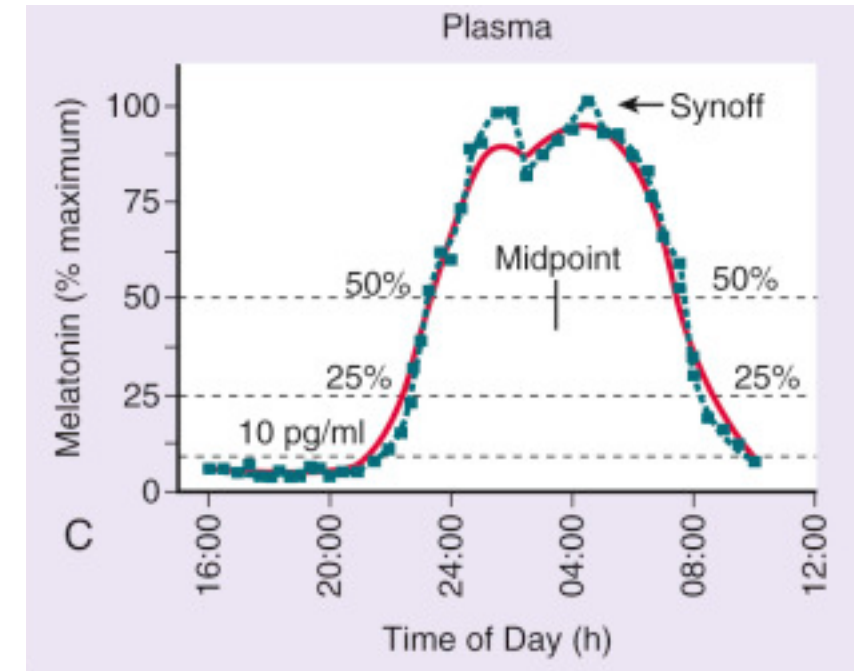
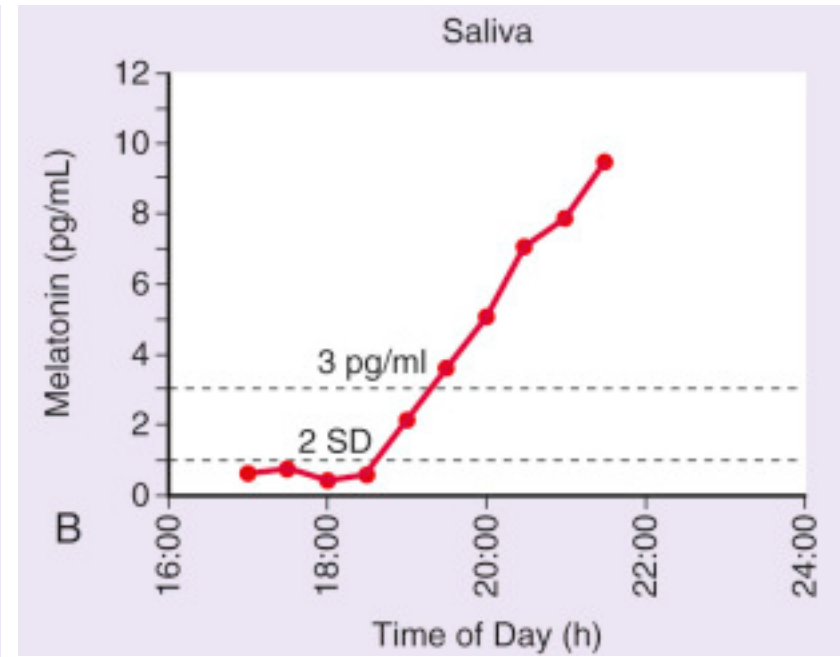
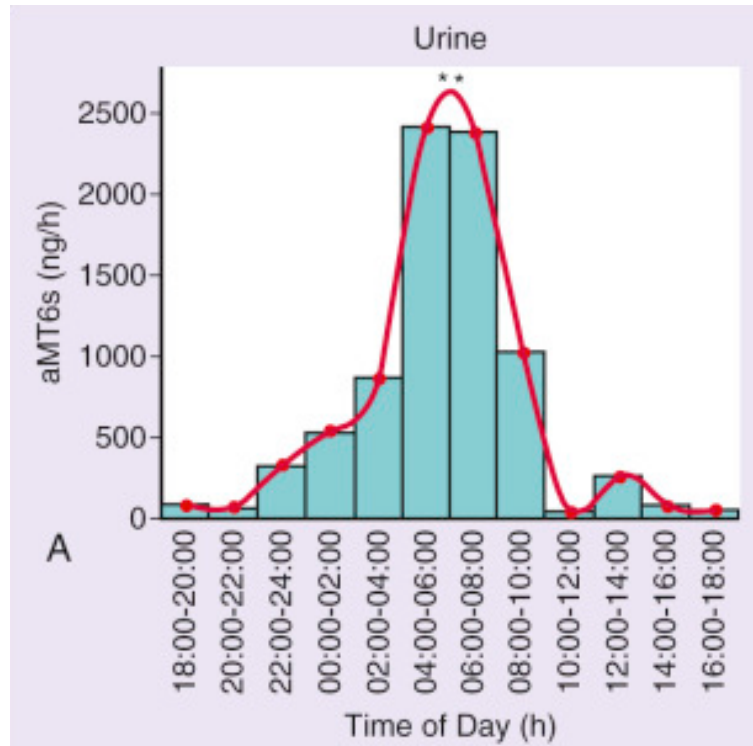


Image: Body Temperature Variation. Project Gutenberg archives. Encyclopaedia Britannica.

# Melatonin





Promising, but limited validation for estimating sleep

Ballistocardiography (BCG)

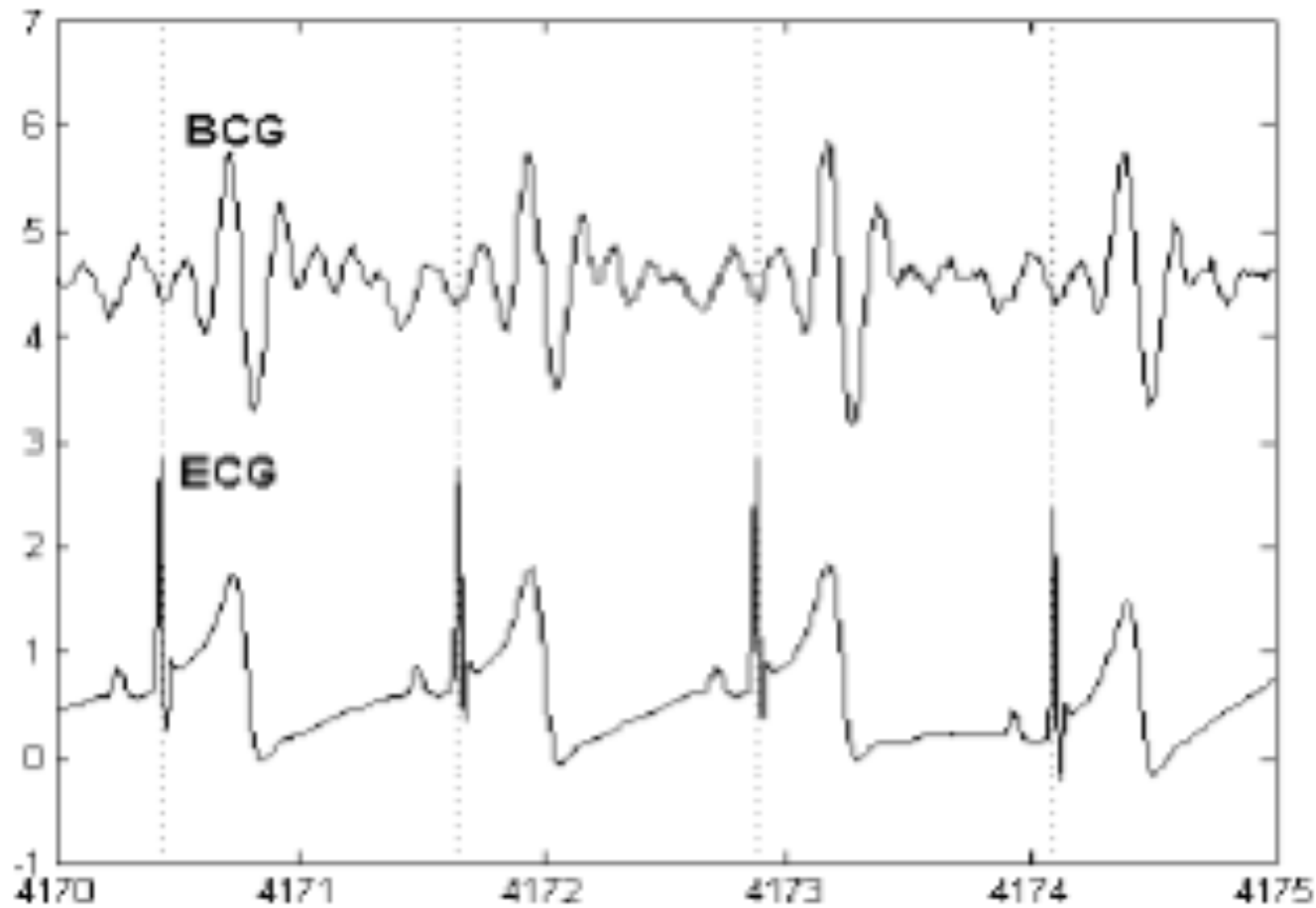


Image 4: General BCG vs. ECG waveforms (Chung et al., 2010)

Promising, but limited validation for estimating sleep

Heart rate variability (HRV)

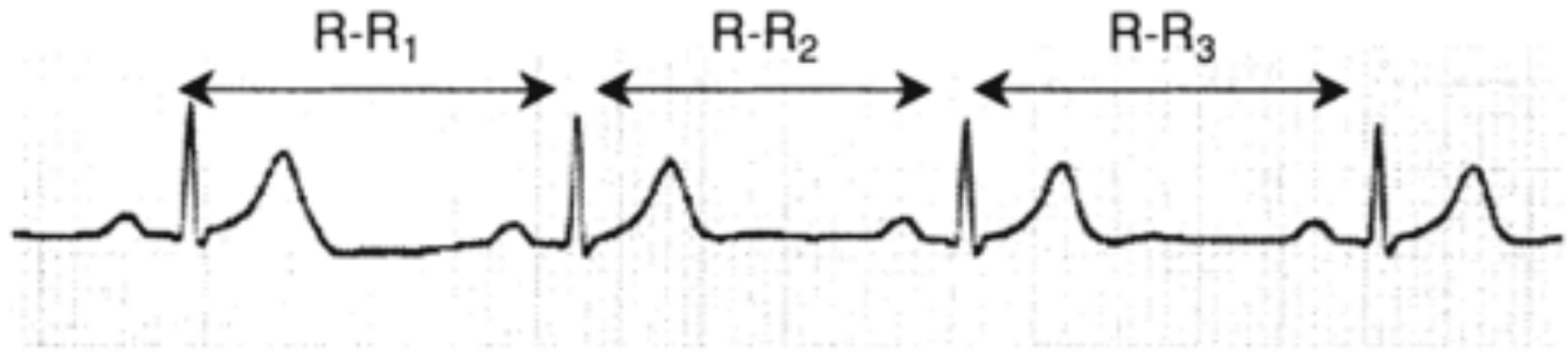


Image 5: Successive R-R intervals. HRV is defined as the time fluctuations between R-R intervals (Brandenberger & Viola, 2005)

Promising, but limited validation for estimating sleep

Electrodermal Activity (EDA)

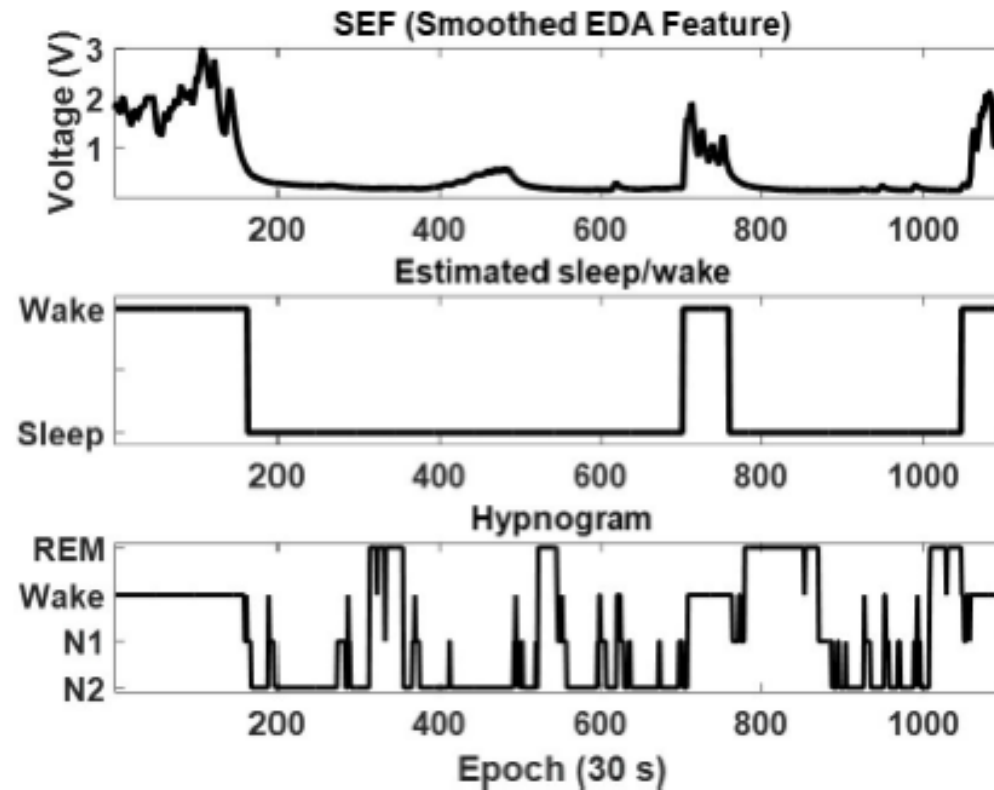


Image 6: EDA (top image) as compared to estimated sleep/wake (middle image) and an actual hypnogram (bottom image) in one subject (Hwang et al., 2015)

# Subjective Measures

- Pittsburgh Sleep Quality Index (PSQI)
- PSQI Addendum for PTSD
- Epworth Sleepiness Scale (ESS)
- Pediatric Sleep Questionnaire (PSQ)
- STOP BANG – screen for OSA
- Global Sleep Assessment Questionnaire
- Stanford Sleepiness Scale (SSS)
- Sleep Disturbance Scale for Children (SDSC)
- Children's Sleep Habits Questionnaire (CHSQ)
- Brief Infant Sleep Questionnaire (BISQ)
- Insomnia Severity Index (ISI)
- Morningness-Eveningness Questionnaire (MEQ)
- Sleep diary



## TWO WEEK SLEEP DIARY



INSTRUCTIONS:

1. Write the date, day of the week, and type of day: Work, School, Day Off, or Vacation.
2. Put the letter "C" in the box when you have coffee, cola or tea. Put "M" when you take any medicine. Put "A" when you drink alcohol. Put "E" when you exercise.
3. Put a line (|) to show when you go to bed. Shade in the box that shows when you think you fell asleep.
4. Shade in all the boxes that show when you are asleep at night or when you take a nap during the day.
5. Leave boxes unshaded to show when you wake up at night and when you are awake during the day.

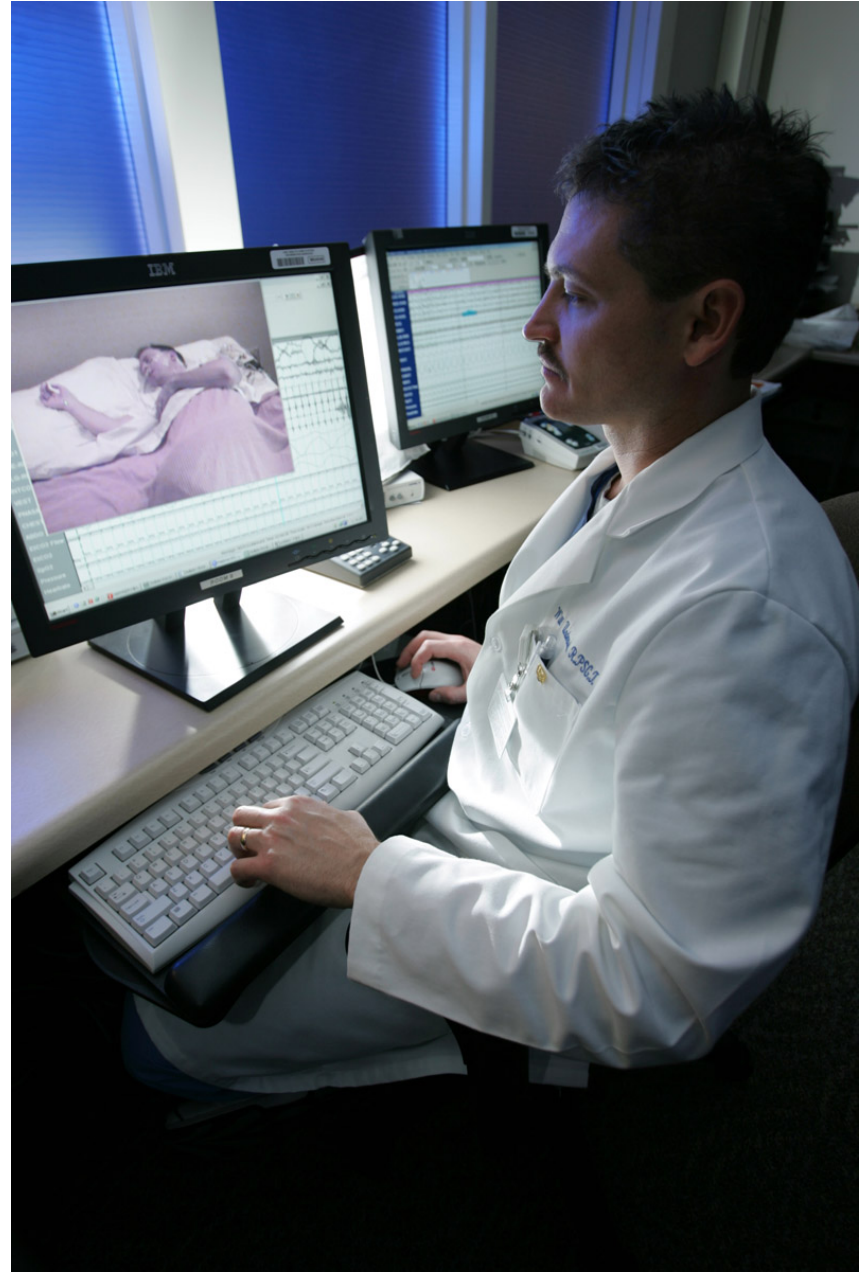
**SAMPLE ENTRY BELOW:** On a Monday when I worked, I jogged on my lunch break at 1 PM, had a glass of wine with dinner at 6 PM, fell asleep watching TV from 7 to 9 PM, went to bed at 10:30 PM, fell asleep around midnight, woke up and couldn't get back to sleep at about 4 AM, went back to sleep from 5 to 7 AM, and had coffee and medicine at 7:00 in the morning.

Today's Date	Day of the week	Type of Day Work, School, or Vacation	Noon	1PM	2	3	4	5	6PM	7	8	9	10	11PM	Midnight	1AM	2	3	4	5	6AM	7	8	9	10	11AM
sample	Mon.	Work		m					A				I									E C				
				</																						

# UNC Facilities



<http://news.unhealthcare.org/uncchildrens/news/2016/march/sleep-grant>





# SON Biobehavioral Laboratory

<http://www.bbl.unc.edu/map.html>

## BIOMARKERS

IL-1 Beta

TNF-Alpha

IL-10

REM - Rapid Eye Movement

Melatonin

BDNF - Brain Derived Neurotrophic Factor

Sleep-Disordered Breathing

Serotonin

Noradrenalin

Dopamine

Acetylcholine

PAT - Peripheral Arterial Tone



Grass EEG/PSG





FROHLICH  
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# National Sleep Research

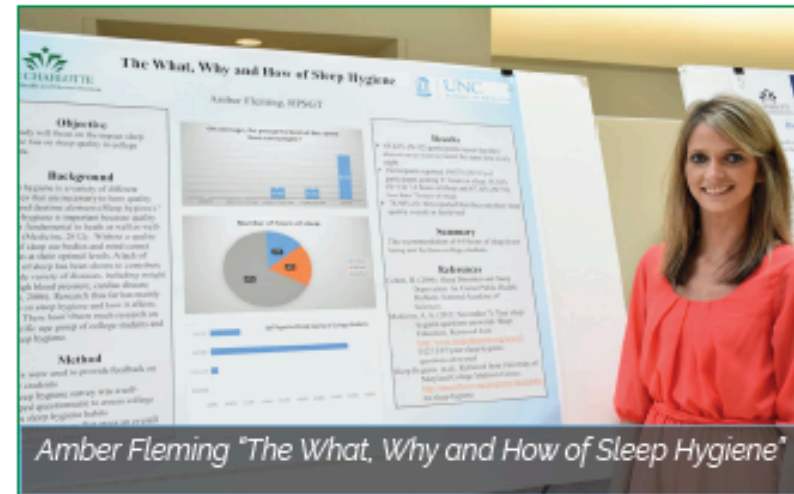
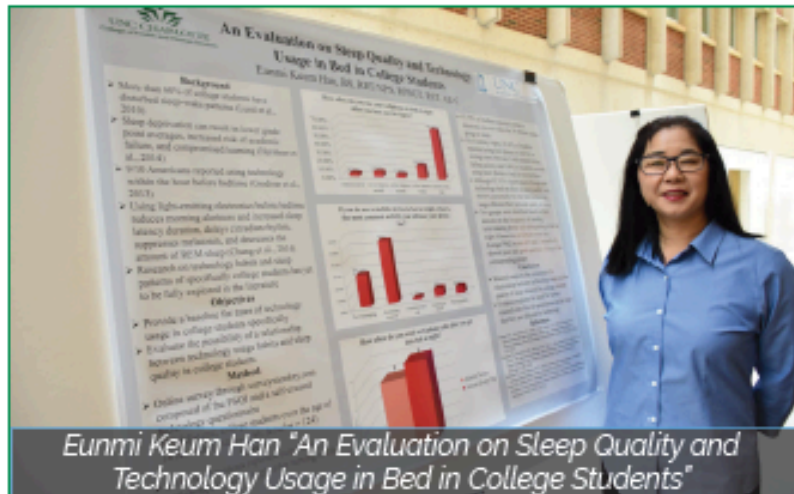
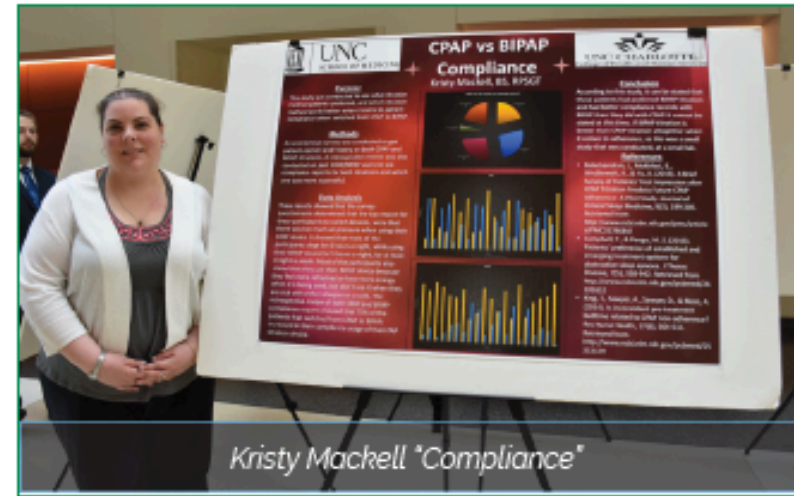
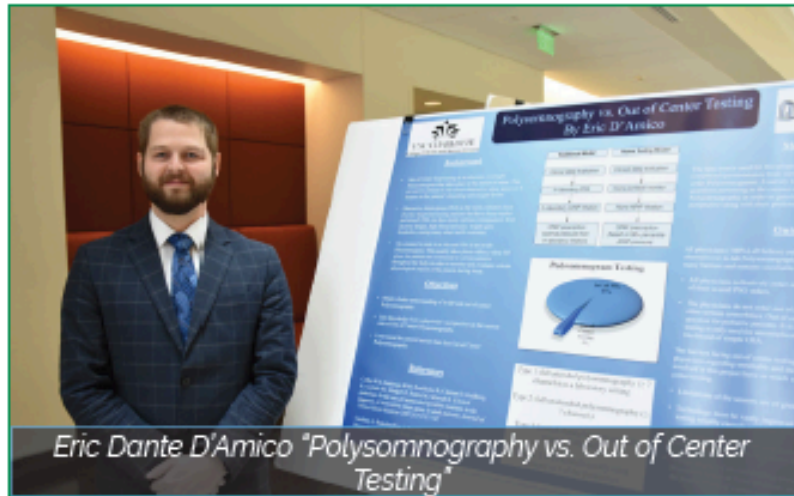
- The Michael Aldrich Sleep Laboratory – University of Michigan
- Core Research Labs – The Stanford Center for Sleep Sciences and Medicine, Stanford University
- Sleep and Chronobiology Center – University of Pittsburgh
- Center for Sleep and Circadian Neurobiology – University of Pennsylvania
- Emory Sleep Research Laboratory
- University of Colorado – Denver
- University of California – San Diego
- Mayo Clinic

# Professional Societies and Associations

- Sleep Research Society
- American Academy of Sleep Medicine
- American Sleep Medicine Foundation
  - Neonatal Sleep
  - Sleep and Congenital Heart Disease
  - Sleep and Alzheimer's Disease
- European Sleep Research Society

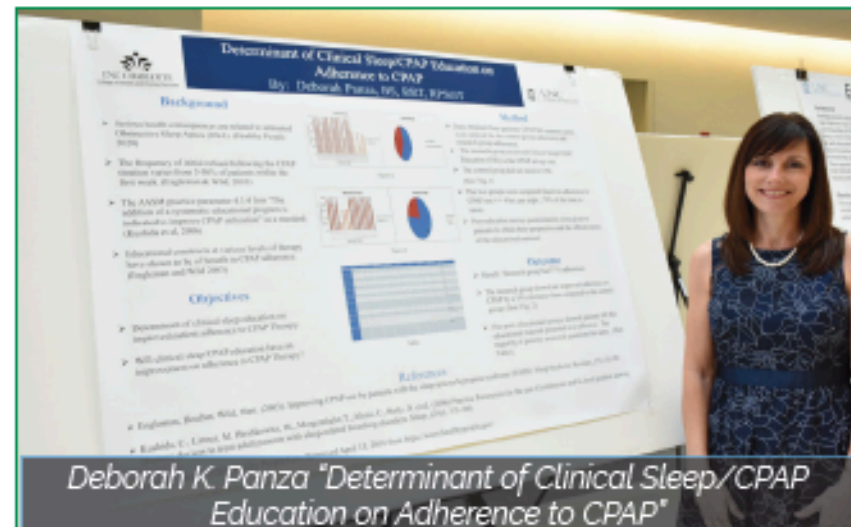
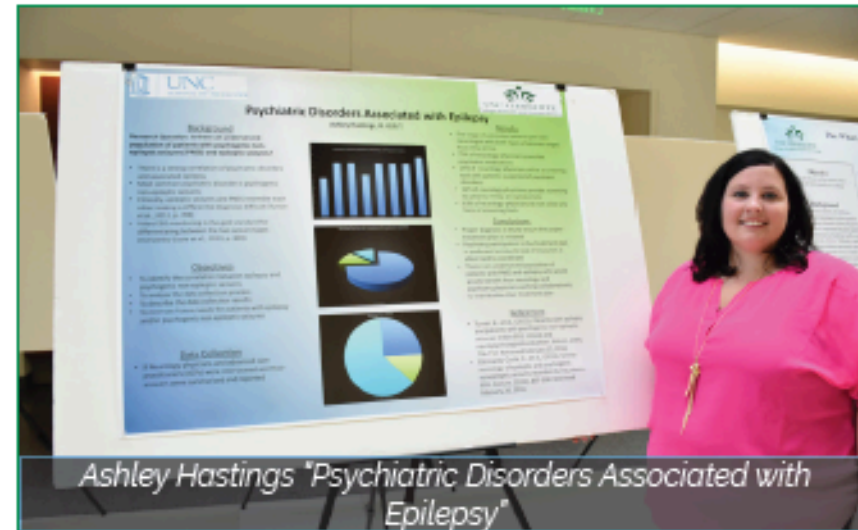
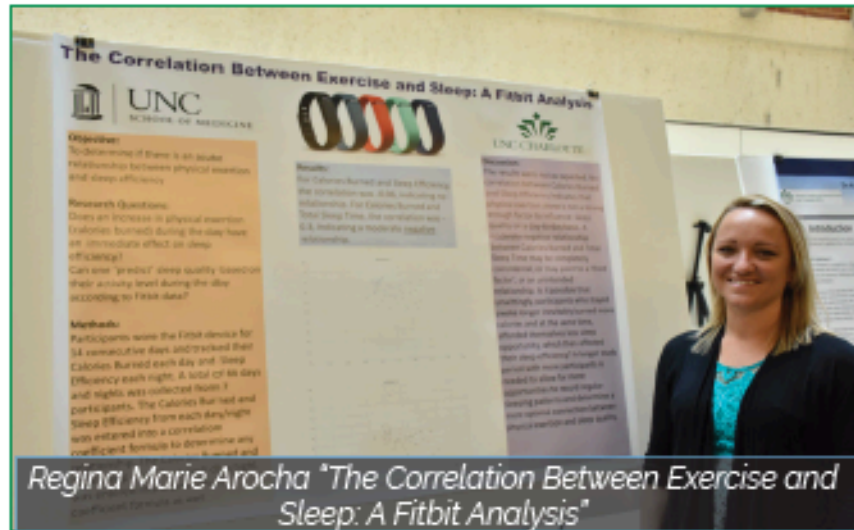


# Student Capstone Research Presentations





# Student Capstone Research Presentations



# 4<sup>th</sup> Annual “A Day of Sleep Symposium” Great Sleep, Great Life

## Student Presenters

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<b>Kristin Annis</b>	<b>Charlene Layer</b>
<b>Brandon Byrd</b>	<b>Bud Millis</b>
<b>Guadalupe Cruz</b>	<b>Marta Rog</b>
<b>Nicole Haddock</b>	<b>Jennifer Tibbitts</b>
<b>Shannon Kerley</b>	<b>Crystal Trotter-Berkley</b>



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## Helpful Links

- National Sleep Foundation <https://sleepfoundation.org/>
- CDC Sleep and Sleep Disorders  
<https://www.cdc.gov/sleep/index.html>
- The National Center on Sleep Disorders Research (NCSDR)  
<https://www.nhlbi.nih.gov/about/org/ncsdr/>
- NIH National Sleep Disorders Research Plan  
<https://tinyurl.com/NIHsleepplan>

*"For the greatest benefit to mankind"*  
*Alfred Nobel*



*The Nobel Assembly at Karolinska Institutet has today decided to award the*

# 2017 NOBEL PRIZE IN PHYSIOLOGY OR MEDICINE





Questions?



Salvador Dali – Dream:  
Flight of Bee around a Pomegranate