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https://tinyurl.com/UNCsmithfamilysleep
NC Leads in Sleep Education
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**
- EMG
- EEG
- EOG

**NREM**
- EMG
- EEG
- EOG

**REM**
- EMG
- EEG
- EOG
Brain Imaging

- PET
- fMRI

Healthy Subject

Awake

REM Sleep

Wires transmit data to a computer. A technician in a nearby room monitors the data.

Sensor at nose to measure air flow

Sensors on face and scalp measure eye movement and brain activity

Elastic belt sensors around chest and belly measure amount of effort to breath

Sensor on finger measures amount of oxygen in blood

http://www.sleep-apnea-guide.com/polysomnogram.html
Body and Brain Temperature

Melatonin

A

Urine

aMT6s (ng/h)

Time of Day (h)

18:00-20:00 22:00-2:00 00:00-2:00 02:00-4:00 04:00-6:00 06:00-08:00 08:00-10:00 10:00-12:00 12:00-14:00 14:00-16:00 16:00-18:00

B

Saliva

Melatonin (pg/mL)

Time of Day (h)

16:00 18:00 20:00 22:00 24:00

3 pg/ml

2 SD

C

Plasma

Melatonin (% maximum)

Time of Day (h)

16:00 20:00 24:00 04:00 08:00 12:00

Synoff

50%

Midpoint

50%

25%

10 pg/ml
Promising, but limited validation for estimating sleep

Ballistocardiography (BCG)

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*Image 4: General BCG vs. ECG waveforms (Chung et al., 2010)*
Promising, but limited validation for estimating sleep

Heart rate variability (HRV)
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
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 | Noon | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM |
|--------------|----------------|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| sample       | Mon.           | Work        | E    |     |     |     |     | A   |     |     |     |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |

| Day of the week | Type of Day | Noon | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM |
|-----------------|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| week 1          |             |      |     |     |     |     |     | A   |     |     |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |

| Day of the week | Type of Day | Noon | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM |
|-----------------|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| week 2          |             |      |     |     |     |     |     | A   |     |     |     |      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |

[Table continued]
UNC Facilities

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
- Seratonin
- Noradrenalin
- Dopamine
- Acetylcholine
- PAT - Peripheral Arterial Tone

Grass EEG/PSG
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

Eric Dante D'Amico "Polysomnography vs. Out of Center Testing"

Kristy Mackell "Compliance"

Eunmi Keum Han "An Evaluation on Sleep Quality and Technology Usage in Bed in College Students"

Amber Fleming "The What, Why and How of Sleep Hygiene"
4th Annual “A Day of Sleep Symposium”
Great Sleep, Great Life

Student Presenters

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

Sponsored by:

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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
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