Measuring Human Sleep
How do we measure our own sleep?

- Retrospective Questionnaires

- Sleep Logs/Sleep Diaries
How do measure other people’s sleep?

- Observer Ratings
- Response to External Stimuli
How do we measure other people’s sleep objectively?

- Movement (Actigraphy)

- Polysomnography

Anderson Cooper gets his sleep studied.
Polysomnography (PSG)

- Three core measures
  - Electroencephalogram (EEG)
  - Electrooculogram (EOG)
  - Electromyogram (EMG)
PSG Hook-Up: EEG

- EEGs placed according to the 10-20 system:
  - C3 & C4: ideal for detecting frequency changes associated with sleep stages
  - Occipital sites: helpful in detecting transition from wake into sleep (alpha activity)
  - Additional sites used to detect regional EEG
PSG Hook-Up: EOG, EMG

- **EOG**
  - LOC: Left Outer Canthus; placed slightly below left eye
  - ROC: Right Outer Canthus; placed slightly above right eye
  - Allows for the detection of horizontal and vertical eye movements

- **EMG**
  - Three chin sites: allows for bipolar recording, with an electrode to spare
  - Additional EMG for research, clinical purposes (e.g. corrugator, tibialis)
Acquiring Data

- Data typically sampled at 200Hz, higher for specific research interests
- Filters:
  - Low frequency: 0.3Hz
  - High frequency: 70Hz
  - Additional high frequency filters can be applied to the EEG channels off-line
- Need lots of hard drive space!
Sleep Staging

- Data divided into epochs
  - Typically 30 seconds
- Each epoch assigned a sleep stage
Relaxed Wakefulness

- EEG: Alpha Activity (8-12 Hz)

- EOG
  - Little movement if closed, voluntary control if open

- EMG
  - Tonic activity, voluntary movement
Stages One and Two

- **EEG**
  - Slows down; Theta activity (4-8 Hz)

- **EOG**
  - Slow Eye Movements (SEMs)

- **EMG**
  - Tonic Activity
Slow Wave Sleep (SWS)

- Stages three and four
- EEG
  - Delta activity (0.5-3 Hz)
- EOG
  - N/A*
- EMG
  - Low level tonic activity
Rapid Eye Movement (REM)

- **EEG**
  - Theta activity
  - Saw-tooth waves

- **EOG**
  - Rapid Eye Movements (REMs)

- **EMG**
  - Muscle Atonia
Sleep Architecture

- 90 minute cycle
- Stage 1: <10%
- Stage 2: 50%
- SWS: 15-20%
- REM: 20-25%
- SWS:REM