

Measuring Human Sleep



How do we measure our own sleep?

- Retrospective Questionnaires



- Sleep Logs/
Sleep Diaries

SLEEP DIARY			
	Date:	Date:	Date:
Morning awakening (time)			
Nap 1 <ul style="list-style-type: none">asleep at (time)what you had to dolength of sleep (minutes)			
Nap 2 <ul style="list-style-type: none">asleep at (time)what you had to dolength of sleep (minutes)			
Bedtime in evening <ul style="list-style-type: none">time went to sleephow long it took (minutes)what you had to do			
Night awakening 1 <ul style="list-style-type: none">awake at (time)how long awake (minutes)what you had to do			
Night awakening 2 <ul style="list-style-type: none">awake at (time)how long awake (minutes)what you had to do			
<ul style="list-style-type: none">How many more awakenings before morning?Any feedings during the night?Did child sleep in your bed at all?			

How do measure other people's sleep?

- Observer Ratings

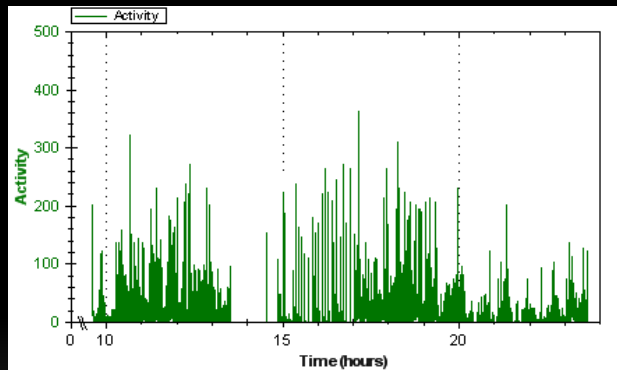


- Response to External Stimuli



How do we measure other people's sleep objectively?

● Movement (Actigraphy)



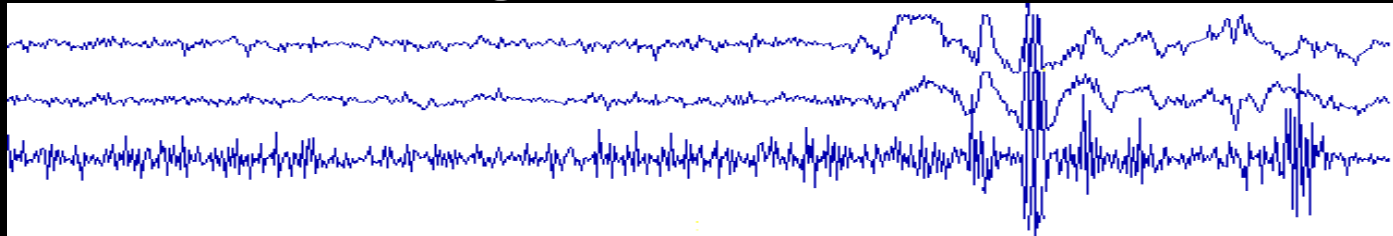
● Polysomnography



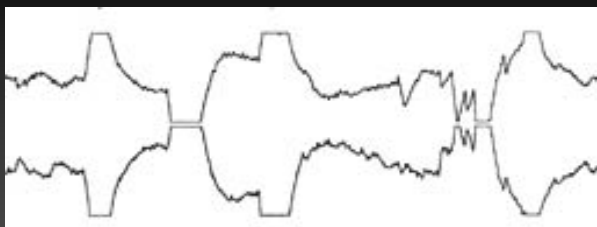
[Anderson Cooper gets his sleep studied](#)

Polysomnography (PSG)

- Three core measures
 - Electroencephalogram (EEG)



- Electrooculogram (EOG)



- Electromyogram (EMG)



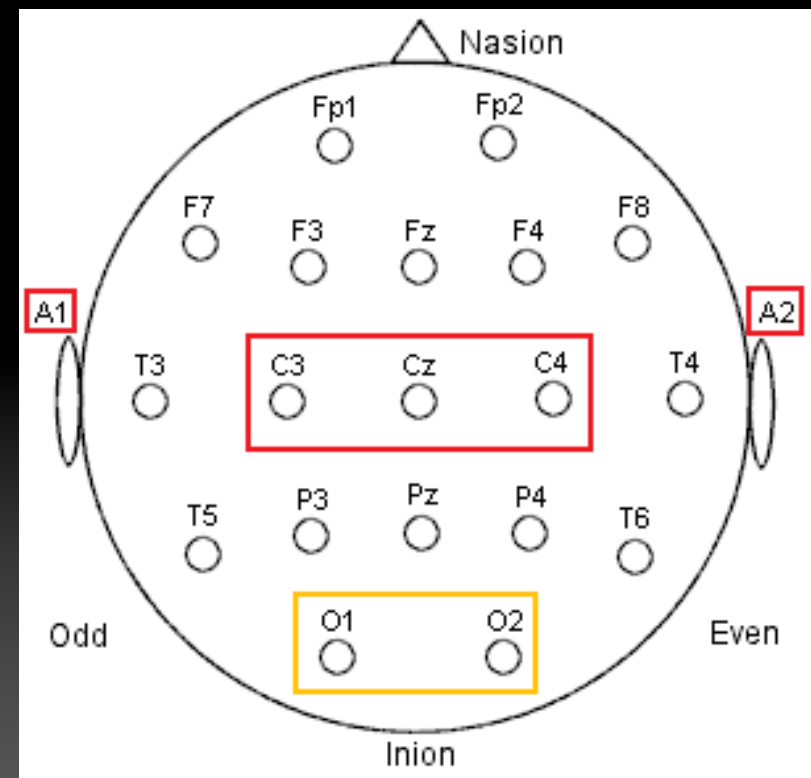
Tonic

Atonic



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



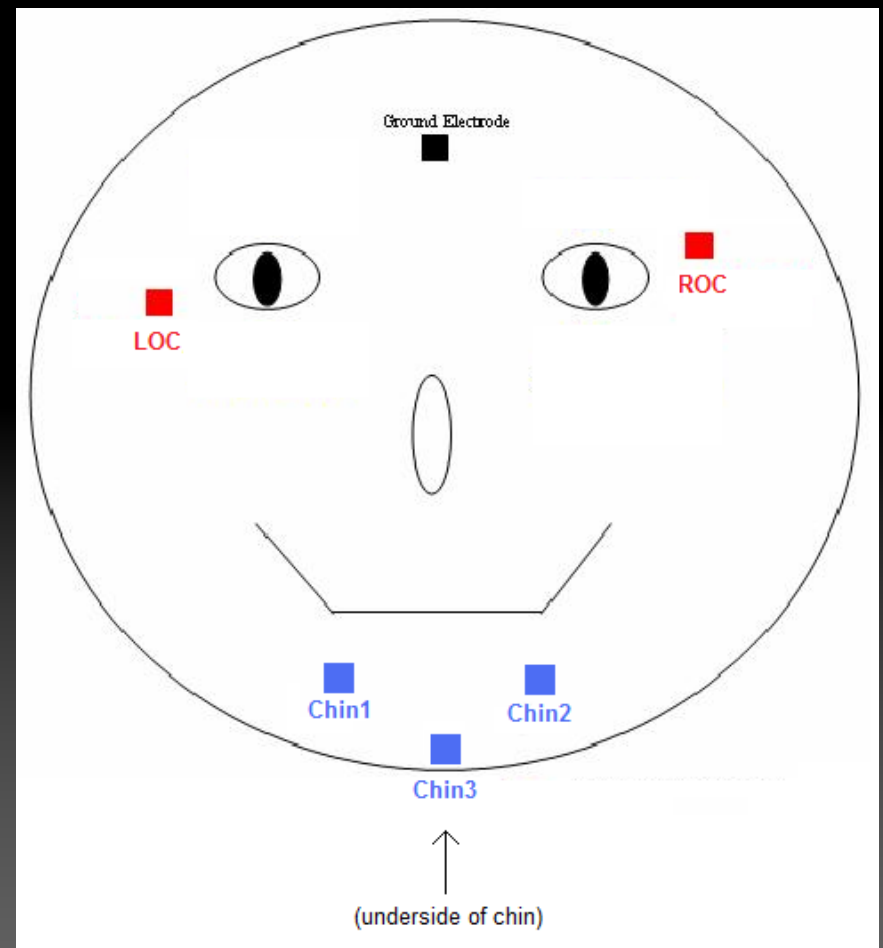
PSG Hook-Up: EOG, EMG

⦿ 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)

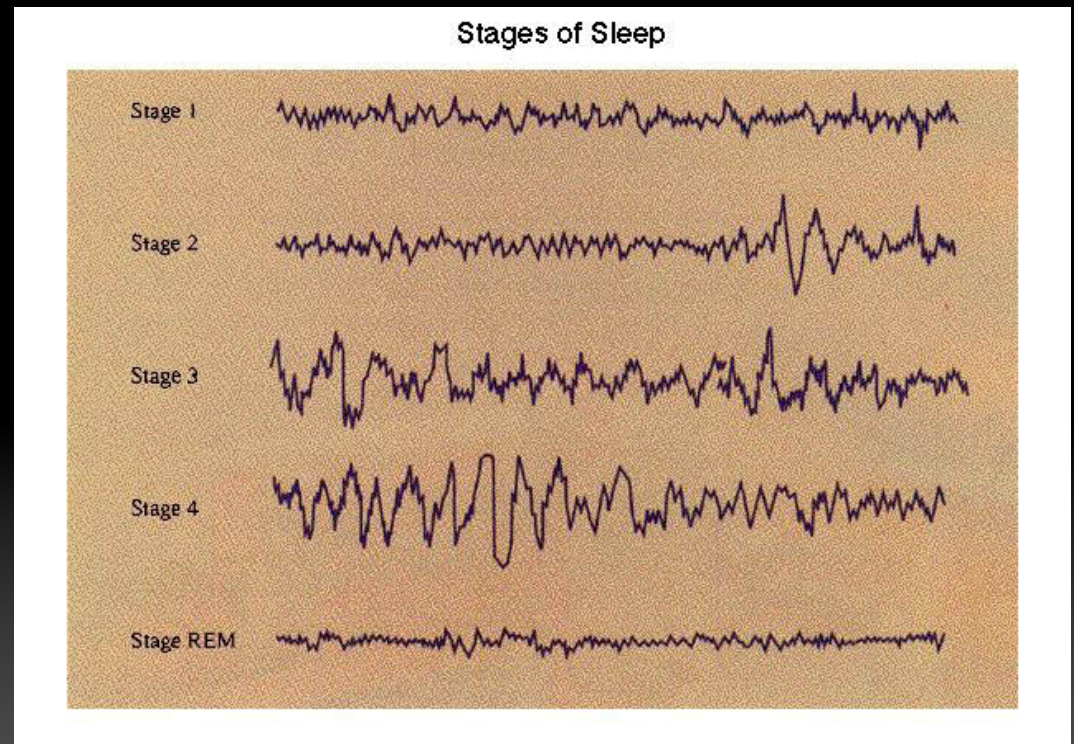


Acquiring Data

- 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)

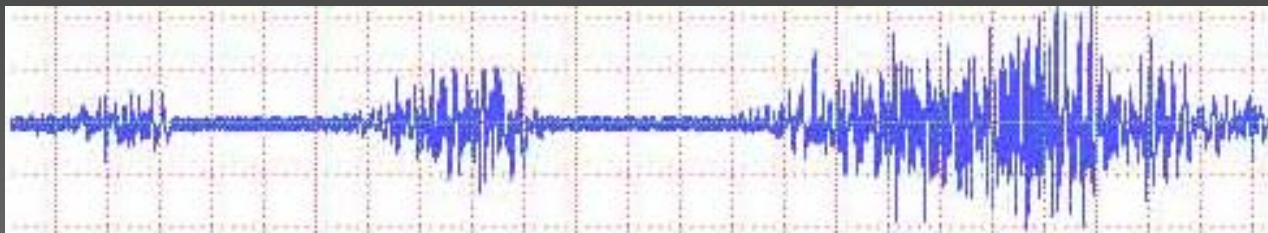


- EOG

- > Little movement if closed, voluntary control if open

- EMG

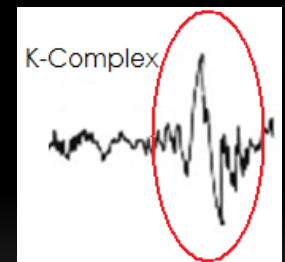
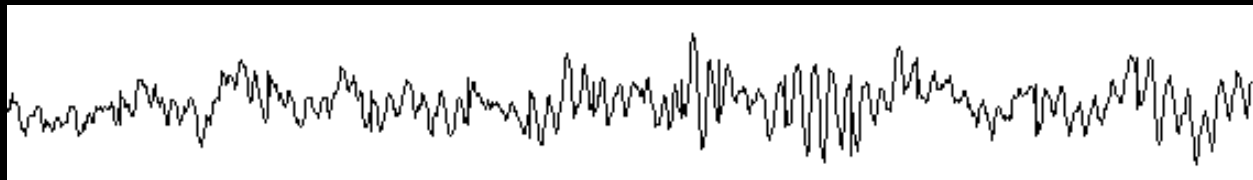
- > Tonic activity, voluntary movement



Stages One and Two

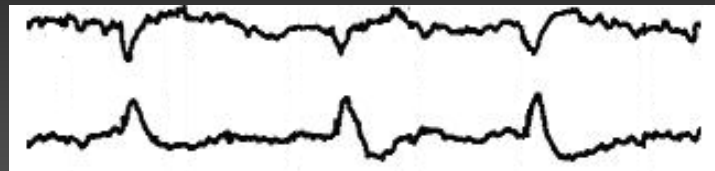
⦿ EEG

- > 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)

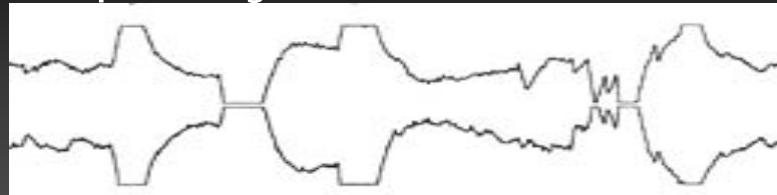
- ⦿ EEG

- > Theta activity
- > Saw-tooth waves



- ⦿ EOG

- > Rapid Eye Movements (REMs)

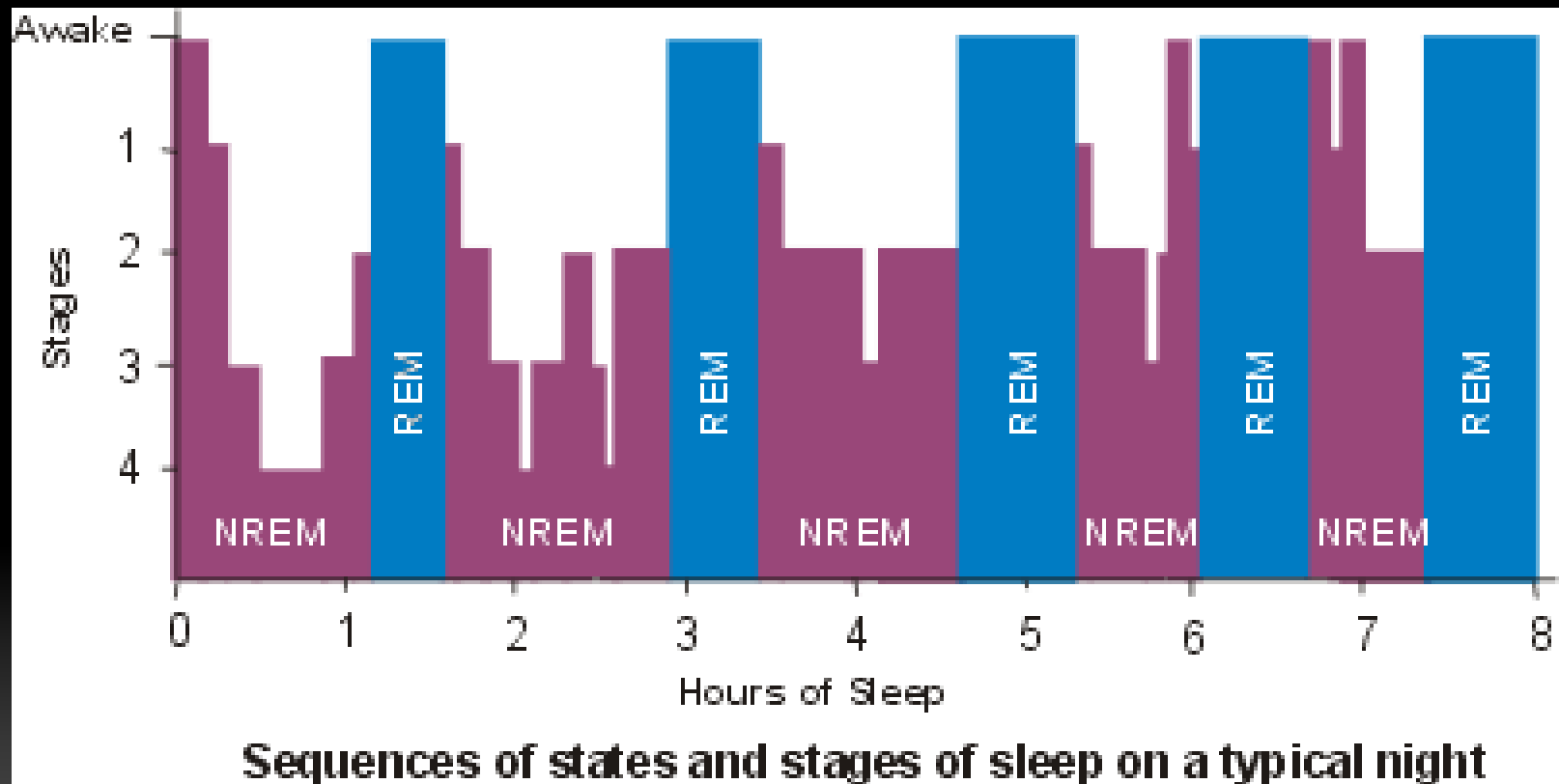


- ⦿ EMG

- > Muscle Atonia



Sleep Architecture



- 90 minute cycle
- Stage 1: <10%
- Stage 2: 50%

- SWS: 15-20%
- REM: 20-25%
- SWS:REM