The Science of Sleep
SLEEP IS NOT an irrational abject attitude of mind toward the supernatural, nature, or God resulting from superstition.
PRIMITIVE DREAM BELIEFS AND PRACTICES ARISE OUT OF COMPLEX AND HIGHLY-DEVELOPED CULTURAL SYSTEMS
CAN YOU DEFINE SLEEP?

• WHAT DO WE SEE OF OTHERS THAT WOULD MAKE US DECIDE SOMEONE WAS ASLEEP?
• WHAT IS HAPPENING TO US WHEN WE SLEEP?
DEFINITION OF SLEEP

• LITTLE MOVEMENT
• TYPICAL POSTURE
• REDUCED RESPONSE TO STIMULATION
• REVERSIBLE
Physiological Sleep

- Sleep is defined by 3 primary physiological measures (time series or waveforms) which are so well correlated with sleep that getting a measure of one provides a pretty good measure of the others.

1. EEG – Electroencephalogram – Brain waves
2. EOG – Electrooculogram – Eye movements
3. EMG – Electromyogram – Muscle tension
SLEEP

SLEEP IS AN ACTIVE RESTORATIVE PROCESS REQUIRING STIMULATION OF CERTAIN BRAIN CENTERS AND INHIBITION OF OTHERS. THE STAGE OF SLEEP IS DEPENDENT ON THE BRAIN WORKING PROPERLY AT THE RIGHT TIME IN THE RIGHT SETTING.
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NORMAL SLEEP

- Average human need is 8.3 hours
- Normal sleep latency: 10 minutes
- Normal sleep structure
  - 5% stage 1
  - 50% stage 2
  - 15-25% stages 3 and 4 (slow wave sleep)
  - 25% REM
- Napping occurs at the beginning and the end of life (in our culture)
SLEEP HYPNOGRAM
Developmental Course of REM Sleep
HYPNOGRAM CHANGES WITH AGE
In Lab Testing
Polysomnography

- Multichannel EEG, O\textsubscript{2} sat, Rhythm, nasal airflow, rib cage movement, abdominal movement, ocular movement
  - Typically done in hospital sleep lab
- Output is scored for:
  - Sleep latency
  - Sleep efficiency
  - Apneas and hypopneas
  - AHI – Apnea-Hypopnea Index
  - Arousals
  - Desaturations
- Clinical challenges:
  - Scoring
  - Diagnostic criteria
  - Patient “learning effect”
  - Lab capacity limitations
Fig. 5-4  This polysomnograph shows 120 seconds of sleep in a sleep epoch. There are 15 channels displayed. The epoch starts in stage 2 sleep. The flow channel (PT-Flow) depicts three apneas. Chest and abdominal channels depict paradoxical motion consistent with obstruction of the extra-thoracic airway. The first apnea is 18.7 seconds in duration and associated with an arousal. Sleep continues as stage 1 sleep with two additional arousals secondary to apneas. The patient is monitored in the left lateral position. No evidence of desaturation below 95% is shown. Maximum apnea length is 22.7 seconds.
BAD SLEEP

- RESTLESS SLEEP
- INSOMNIA
- OBSTRUCTIVE SLEEP APNEA
- NARCOLEPSY
- PARASOMNIAS
- SLEEP STATE MISPERCEPTION
INSOMNIA / RESTLESS SLEEP

• RESTLESS LEG SYNDROME
• PERIODIC LEG MOVEMENT DISORDER
• STRESS/PSYCHIATRIC DISORDERS
• SLEEP APNEA (OSA)/UPPER AIRWAY RESISTANCE SYNDROME (UARS)
• GASTROESOPHAGEAL REFLUX
SLEEP HISTORY

• CIRCADIAN STATE
• SLEEP ENVIRONMENT
• SLEEP LATENCY
• AROUSALS
• SNORING / APNEA
• DAYTIME SLEEP
PARASOMNIA / DYSOMNIA

- SLEEP RELATED “BEHAVIORS”
- CAN HAVE VIVID RECALL
- MAYBE DREAM OR NOT DREAM RELATED
- MAY BE VIOLENT
- YOU CAN AWAKE OUT OF THESE WITHOUT DANGER!
- BEHAVIORS MAYBE AT TIMES COMPLEX
PARASOMNIA / DYSOMNIA

- STEROETYPIC BEHAVIORS CAN HAPPEN
- AGGRAVATED BEHAVIORS
- MUNDANE BEHAVIORS
- COMPLEX BEHAVIORS
  - SLEEP EATING / DRINKING
  - MUSIC / DANCING
  - SEX
  - WALKING / DRIVING
  - PAINTING
EXCESSIVE DAYTIME SLEEPINESS

• HIGHLY VARIABLE ACCURANCE
• EPWORTH SCORE OR OTHER SCALES FOR EVALUATION HELPFUL
• SLEEPINESS
  – INCREASE MORBIDITY
  – GOOD PROGNOSTIC INDICATOR
MANIFESTATIONS OF EXCESSIVE SLEEPINESS

• TENDENCY TO FALL ASLEEP EASILY
• SLEEP ATTACKS (without warning during ‘any’ activity !)
• FREQUENT DAYTIME NAPPING
• AMNESTIC EPISODES WITH AUTOMATIC BEHAVIOR
DISORDER OF EXCESSIVE SLEEPINESS (EDS)

- INADIQUATE SLEEP SYNDROME
- SLEEP APNEA 60-75% OF EDS
- NARCOLEPSY 20% OF EDS (1/2000)
- PLMS 5% OF EDS
- IDIOPATHIC HYPERSOMNOLENCE 1%
- DEPRESSION 15-20% OF DEPRESSED HAVE SLEEPINESS
SLEEP DISORDERED BREATHING

• OBSTRUCTIVE SLEEP APNEA
• CENTRAL SLEEP APNEA
• MIXED APNEA SYNDROME (complex)
• CHEYNE STOKES BREATHING
• UPPER AIRWAY RESISTANCE SYNDROME
SLEEP APNEA...SLEEP DISORDERED BREATHING is a condition of frequent episodes of breathing pauses during sleep

**COMMONLY USED METRIC:**

#APNEA & HYPOPNEA /HR OF SLEEP

(AHI)

Pauses are due to episodes of loss of central “signal” to respiratory muscles

or sleep-induced episodes of complete or partial upper airway collapse .....OR BOTH
ACUTE EFFECTS OF APNEA AND HYPOPNEA WITH POSSIBLE CVD CONSEQUENCES:

- Exposition to repeated hypoxic episodes
- Large swings in BP
- Arrhythmias
- Bursts of bradycardia and tachycardia
- Increased sympathetic nerve activity
- Increased intrathoracic negative pressure
- Fragmented sleep
SDB AND INSULIN RESISTANCE

• NOT DEPENDENT ON BODY MASS INDEX
• “EACH ADDITIONAL APNEA / HOUR INCREASED THE FASTING INSULIN LEVEL”
• INCREASED INSULIN LEVELS MOST PRONE TO DEVELOPMENT OF HTN
SDB / INSULIN RESISTANCE

• INSULIN RESISTANCE MORE PREVELANT WITH SEVERITY OF HYPOXEMIA

  » AM J OF RESP CRITICAL CARE
  » MARY ET EL VOL 165, 670-676  2002
  » NARESH ET EL VOL 165, 677-682  2002
Mandibular Advancement

SomnoDent MAS™
| 1. | Restorative Hypothesis               |
| 2. | Energy Conservation Hypothesis      |
| 3. | Predator Avoidance Hypothesis       |
| 4. | Brain Growth Hypothesis             |
| 5. | Binocular Coulometer Hypothesis     |
| 6. | Consolidation of Memory Hypothesis  |
| 7. | Erasure of Memory Hypothesis        |
| 8. | Discharge of Harmful Emotion Hypothesis |
| 9. | Maintenance of Homeothermy Hypothesis |
"Dreaming permits each and every one of us to be quietly and safely insane every night of our lives."

William Dement
Theories of the Function of REM Sleep

1. The activation-synthesis hypothesis
2. The catecholamine-restoration hypothesis
3. The cortical homeostasis hypothesis
4. The drive facilitation hypothesis
5. The information processing hypothesis
6. The neural growth hypothesis
7. The oculomotor hypothesis
8. The protein synthesis hypothesis
9. The sentinel hypothesis
When do we dream?

- **REM Sleep** 85% – 90%
- **NREM Sleep**
  - Stage 1 and 2 70% - 75%
  - Stage 3 and 4 ~50%
- **Sleep Onset**
  - Alpha waves 30% - 40%
- **Wakefulness** ~20%
1. Emotional processes construct dreams – forbidden unconscious wishes


3. Variation on 2. – continual sensory input to the mind/brain is necessary for it to produce rational thought; during sleep input is reduced.
Sigmund Freud
(1856 – 1939)

- The Interpretations of Dreams: Dreams have decipherable meanings relating to unconscious conflict and had a universal applicability. Freud model – sexual and aggressive drives seeking satisfaction.
Crick and Mitchison saw the brain to be a lot like a computer and claimed that dreaming was when the brain sifts through information from the day and discards unwanted information. They also suggest that the dreaming period allows for an individual to forget through "reverse learning". They claim that the content of dreams hold no significance and are merely a by-product of the reverse learning process.
Evans claims that the brain reorganizes material during dreaming and actually integrates new material with memories that are already stored in long term memory. Therefore this suggests that problem-solving may occur while we dream.
The construction of dreams is more strongly related to certain cognitive skills than to psychosocial or emotional status. The construction of dreams depends upon the presence of cognitive abilities to analyze, abstract manipulate and construct visuospatial images or ideas.
Dream Experiences

- Traditional View – dreams were bizarre, unrealistic experiences that were emotionally charged with inappropriate feeling. Modern View – mundane, realistic experiences in which the dreamer has modest feelings appropriate to the dream situation.
Dream Content

• Before modern sleep laboratory research, dream reports were usually short and dreams were considered to be instantaneous experiences.

• Dream reports
  – Long reports – one or more typewritten
  – Word counts
  – Dream duration studies
Dream Research (Depression)

- Freud (1917) – mourning depression – anger at being left behind
- Beck and Ward (1961) – loss/failure not anger/hostility
- Weissman (1971) – intense anger toward close friends and relatives
- The act of cutting down of a tall tree in dreams (manifest content) symbolizes the patient’s anger towards his father (latent content)
Dream Research

(Gestalt Therapy)

| • Every image in the dream, whether human, animal, vegetable, or mineral, is taken to represent an alienated potion of the self. By re-experiencing or retelling the dream over and over again in the present tense, from the standpoint of each image, the patient can begin to reclaim these alienated fragments, and accept them, live with them and express them more appropriately (Enright, 1970) |
| • “A woman dreams of walking down a crooked path among tall trees, straight trees.” |
Dream Research

(Phobias)

- Psychoanalytic treatment of phobias – uncover repressed conflict that underlie fear and avoidance.

Free Associations – the analyst attempts to discover clues to the repressed origins of phobias in the manifest content of dreams.
What Dreams are made of:

- Dreams are not:
  - Faithful reproductions of memory
  - Little thematic coherence between stages
  - Related to pre-sleep stimuli
- Dreams are:
  - Coherent in theme while in stage
  - Marginally related to stimuli during sleep
  - Focused only on the dream experience
BEHAVIORS DURING THE NIGHT

• RBD (REM BEHAVIOR)
• DISORDER OF PARTIAL AROUSAL
• SEIZURES
• EPISODIC NOCTURNAL WANDERINGS
REM BEHAVIOR

• DREAM SLEEP IS A PARALYTIC STATE
• THERE ARE NORMAL CONTROLS TO ALLOW FOR DREAM STABILITY
• LOSS OF PARALYTIC CONTROLS
  » PHONATION
  » MOVEMENT
  » TOTAL DREAM PARTICIPATION
  » AGGRAVATED BEHAVIOR
OTHER THINGS

• SLEEP STARTS
• HYPNAGOGIC OR HYPNOPOMPIC HALLUCINATIONS
• SLEEP PARALYSIS
• CONFUSIONAL STATES
• SEIZURES
DSM-IV-TR to DSM-5

- Neurodevelopmental Disorders
- Obsessive-Compulsive and Related Disorders
- Trauma and Stressor-Related Disorders
- Somatic Symptom and Related Disorders
- Feeding and Eating Disorders
- Sexual Dysfunctions
- Disruptive, Impulse-Control, and Conduct Disorder.
DSM-IV-TR to DSM-5

- Gender Dysphoria
- Substance-Related and Addictive Disorders
- Neurocognitive Disorders
- Paraphilic Disorders