Chapter 3 - Consciousness:

Awareness of one's own mental activity (sensations, feelings & thoughts) and of the external world

Not one type of consciousness, but a "continuum" of different levels, from extreme alertness to the deepest coma or "vegetative state"

But consciousness does not reflect all that the brain is doing

• Information is often simultaneously processed on separate conscious and unconscious tracks

• We are unaware of the great deal of brain processing occurring in the unconscious track

Dual Processing: The Two-Track Mind

• Researcher Lawrence Weiskrantz tested patients with damage to their conscious visual pathway but an intact unconscious visual pathway.

• Although told that the cluttered hallway was empty, the patient meandered around all the obstacles without any conscious awareness of them.

• Simultaneous processing of the location, shape and dimensions of visual stimuli are processed at the unconscious level.

"Blindsight" - when the blind can "see" despite the lack of conscious visual sensation

Biorhythms

• Regular, periodic fluctuations in biological & psychological functioning

• Most common: **circadian rhythms** - 24 hr cycles (e.g. sleep, body temp, hormone release)

• Regulated by a biological clock in the hypothalamus: the suprachiasmatic nucleus (SCN) (Fig 3.12)

• This clock is set/reset by the day/night cycle – especially by morning light

• But the clock will keep the rhythms going even in the absence of the day/night cycle

• Shift workers are fighting their biological rhythms

• Research on circadian rhythms:
  * http://www.youtube.com/watch?v=f2B6hl7wu90

Suprachiasmatic Nucleus (SCN)

- The SCN tells our Pineal Gland to secrete melatonin as light decreases in evening→gradually makes you sleepy

- But our modern day lights, computer screens, TVs, and even glowing LED displays can screw this up
Are you morning person (lark) or an evening person (owl)?

A “lark” person’s biorhythms may be 3 hours ahead of an “owl” person’s biorhythm

- Peak performance hrs vary with our rhythm
- Rhythm tends to change with age – owls become larks as they get older

Sleep Lab or Clinic

- Monitor:
  - EEG (brain waves)
  - EOG (eye movements)
  - EMG (muscle tension)

The Stages in a Typical Night’s Sleep

http://www.youtube.com/watch?v=qEWbu37fH9k
http://www.youtube.com/watch?v=npK2sbVVJ2c
http://www.youtube.com/watch?v=sipK2s0VVyY
2 Main Types of Sleep

- NREM (about 80% of night)
- REM or Dream Sleep (20% of night)

Characteristics of NREM Sleep

- gradual decrease in movements, breathing, heart rate
- slow, rhythmical brain waves ("delta waves")
- hard to wake up
- If awakened you’re likely to say you were thinking. Only rarely (10%) do you dream in NREM.

REM Sleep

- very active brain waves similar to waking
- total loss of tone in most muscles
- rapid jerky eye movements (REMs)
- breathing, heart rate unpredictable
- 80-90% chance of vivid dream report
- erections; vaginal lubrication; regardless of dream content

Why Do We Sleep?

- Sleep played a protective role for our distant ancestors by keeping them safe during potentially dangerous periods.
- Sleep helps people recuperate (for example, by restoring and repairing damaged neurons). The immune system is active during sleep.
- Sleep helps grow and strengthen neural connections that build enduring memories.
- Sleep promotes creative problem solving the next day.
- During deep sleep, the pituitary gland secretes a growth hormone necessary for growth and muscle development.

Adaptation/Protection Theory

Cross-species Comparisons of Daily Hours of Sleep

“Safe” sleepers sleep longer; vulnerable sleepers sleep less.

Total Sleep Over Lifespan

- Infants
- Children
- Adults

[Bar chart showing total sleep over lifespan]
Although today’s sleep researchers debate dreams’ functions—and some are skeptical that dreams serve any function—there is one thing they agree on: We need REM sleep.

• Deprived of REM sleep by repeated awakenings, people return more and more quickly to the REM stage
• When finally allowed to sleep undisturbed, they make up for lost REM with increased REM sleep, a phenomenon called REM rebound

Sample Dream Theories

<table>
<thead>
<tr>
<th>Theory</th>
<th>Explanation</th>
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<tbody>
<tr>
<td>Lucid sleep</td>
<td>Dreams provide a “psychotherapeutic outlet” and are a way for the brain to process emotions and events.</td>
</tr>
<tr>
<td>Information processing</td>
<td>Dreams help us sort out the day’s events and consolidate new memories.</td>
</tr>
<tr>
<td>Physiological function</td>
<td>Regular brain stimulation from REM sleep may help develop and preserve neural pathways.</td>
</tr>
<tr>
<td>Neural activation</td>
<td>REM sleep triggers neural activity that maintains cerebral neural networks, which are sleeping branched into:</td>
</tr>
</tbody>
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Sleep is a necessity, not a luxury

• Quality of sleep determines:
  • our mood, alertness, energy, thinking, productivity, and safety
  • general health & longevity
• Sleeping brain is highly active and:
  • regulates immune, hormone, and cardiovascular functions
  • replenishes neurotransmitters
• We are abusing sleep (since 1879).

REM Sleep Over Lifespan

Sleep Crisis

• Majority of adults & adolescents are moderately to severely sleep deprived!
• 63% suffer sleep disorders/problems
• Major health & economic problem

How Sleep Deprivation Affects Us
Insufficient Sleep Associated With:

- Drowsiness; unintended sleep
- Increased irritability, anxiety, depression
- Decreased socialization & sense of humor
- Decreased cognitive & athletic performance
- Slowed reaction time; increased errors
- Decreased concentration, memory, problem-solving, creativity, decision-making
- Decreased quality of work & productivity
- Decreased health & immune function
- Increased weight & BP

- For all of us: Driving sleepy is as dangerous as driving drunk!! 1 in 6 single driver fatal crashes is due to falling asleep at the wheel!

Effect of sleep deprivation on brain activation (math)

Canadian Traffic Accidents

After the spring time change when people lose one hour of sleep accidents increased. 50% of fatal crashes are sleep related. Similar data from the USA

High School Study of Accident Rates of >20,000 Students

Those at schools starting 75 minutes later had 25% fewer accidents than students at schools starting early.

NREM Sleep “Disorders”

- Tend to run in families
- Very common in kids. Most outgrow them—only a few adults continue to experience some episodes of NREM disorders.
- Sleep-walking (17% of kids [peaking at 8-12 yrs], 4% of adults)
- Night terrors (3% of kids, mostly < 6 yrs)
- Bed-wetting (enuresis)

REM Sleep Disorders

- Much more rare than NREM problems
- Narcolepsy - REM sleep “attacks” with cataplexy, muscle paralysis, & hypothalamic hallucinations. Often triggered by emotion.
- Animal Model of narcolepsy allows research Several meds can decrease sleep attacks of narcolepsy:
  - Stimulants like Ritalin and amphetamine
  - Somewhat safer Provigil
  - or by deepening sleep at night with Xyrem
REM Behavior Disorder

• REM behavior disorder - failure of the usual muscle paralysis mechanism of REM so the person can move during dreaming
• Unlike narcolepsy, REM behavior disorder usually occurs in older individuals
  • May be associated brain damage/neurological diseases like Parkinson’s disease
  • May be triggered by drug use in some
• Treatment – medications that decrease REM

Other Sleep Problems

• Insomnia (over 60 varieties/causes)
  • OTC sleeping pills contain antihistamine (diphenhydramine)
  • Melatonin also available
  • Prescription
    • Benzodiazepines: (Xanax, Dalmane, Restoril)
    • Non-benzodiazepines (Ambien, Lunesta, Sonata)
  • Risks: tolerance, dependence, side effects, REM suppression
  • Melatonin: like Rozerem
• Sleep Apnea- repeated abnormal pauses in breathing during sleep
  • Most common treatment: CPAP
• Both of these as well as our lifestyles can put us into “sleep debt”

A biorhythm related disorder: Seasonal Affective Disorder (SAD)

• Depression that cycles with the seasons, occurring in fall/winter & going away in the spring, most often in regions that experience the largest changes in daylight hours (7.3% rate in NH vs 1.4% rate in Florida)
• Excessive lethargy, sleepiness, overeating
• Majority will benefit from the artificial lengthening of short winter days