



Consciousness 2: Sleep and Psychoactive drugs

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Consciousness & Sleep



Sleep definition

- Periodic, natural, reversible loss of consciousness



Why do we sleep?

- Humans have the tendency to think that most of what we do has a special, higher-order function.
 - EXAMPLE – It is suggested that sleep helps re-program the complex brain, or that it permits some kind of emotional release to maintain our mental health.
 - Basic sleep theories: Consolidation, restorative function
- However - virtually all mammals and birds sleep in much the same way:
 - high amplitude, low frequency EEG waves, punctuated by periods of low-amplitude, high frequency activity.
- ⇒ suggestion that sleep serves a critical function!



Theoretical approaches to the function of sleep

- Recuperation theories
 - Being awake disrupts the homeostasis of the body in some way and that some sleep is required to restore it.
- Circadian theories
 - Sleep is not a response to internal imbalance. A neural mechanism has evolved to encourage animals to sleep in those times of day when they do not usually engage in activities necessary for their survival



Discussion point

- Based on these theories, why do cats tend to sleep 14 hours a day, and horses only sleep 2?



The number of hours of sleep per day averaged by various species

<i>Hours of sleep per Day</i>	<i>Species</i>
20	Giant sloth
19	Possum, brown bat
18	Giant armadillo
17	Owl monkey, nine-banded armadillo
16	Arctic ground squirrel
15	Tree shrew
14	Cat, golden hamster
13	Mouse, rat, grey wolf, ground squirrel
12	Arctic fox, chinchilla, gorilla, raccoon
11	Mountain beaver
10	Jaguar, vervet monkey, hedgehog
9	Rhesus monkey, chimpanzee, baboon
8	Human, rabbit, guinea pig, pig
6	Grey seal
3	Cow, goat, elephant, donkey, sheep
2	Deer, horse



Back to the drawing board

- **Recuperative theories**
 - Suggest that species that expend more energy should sleep longer
 - However, no apparent correlation between species' time and its level of activity, body size, or temperature.
 - Giant sloth
- **Circadian theory**
 - Predicts that daily sleep time of each species is related to how vulnerable it is while it is asleep as well as how much time it requires each day to feed itself and to take care of its survival needs.
 - lions Vs. deer



Circadian Rhythm

- Most animals display a Circadian rhythm, a periodical / rhythmical alternation of various physiological and behavioural functions, synchronised to the 24-hour cycle of light and dark
- Regular bodily rhythms, such as of wakefulness and body temperature, that occur on a 24-hour cycle, consisting of the rise and fall of certain neurotransmitters and hormones
 - Epinephrine (associated with *arousal*) reaches peak in late morning and steadily declines until midnight when it drops severely until morning
 - Melatonin (associated with *drowsiness*) surges at night and drops off during the day



Neuropsychological location

- ***Suprachiasmatic Nucleus*** (SN)– A tiny cluster of neurons situated in the hypothalamus directly above the optic chiasma (junction of the two optic nerves en route to the brain). Nerve fibres branch off from the main nerve and penetrated hypothalamus above, forming synaptic connections with cells in the SN. The retina projects directly onto the SN, which ensures that the sleep-wake cycle is tuned to the rhythm of night and day.
- → If this connection is severed, the cycle is permanently disrupted.



Circadian rhythms

- ***Michel Siffre*** (1972)
 - French cave explorer spent 7 months underground with no external cues as to time of day.
 - Organised his life into ordinary pattern of activity, sleep, and normal meal pattern.
 - → Body adopted a 25 hour day.



Class discussion

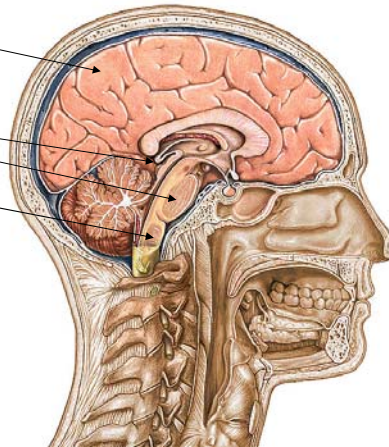
- Is the biological clock therefore an internal property of the system?

Environmental cues: Rhythms of sleep

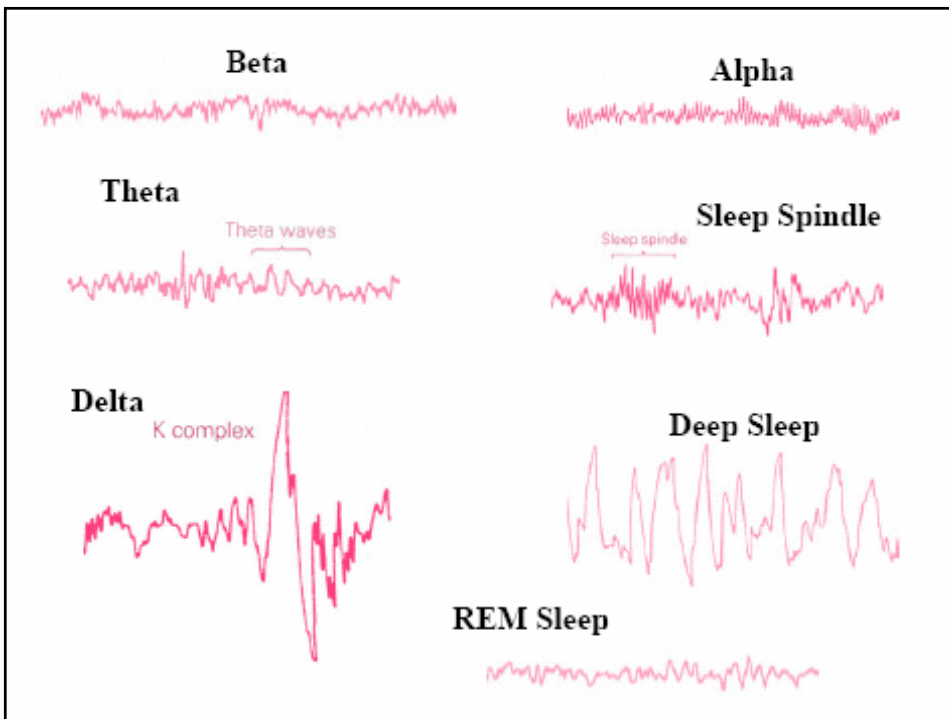
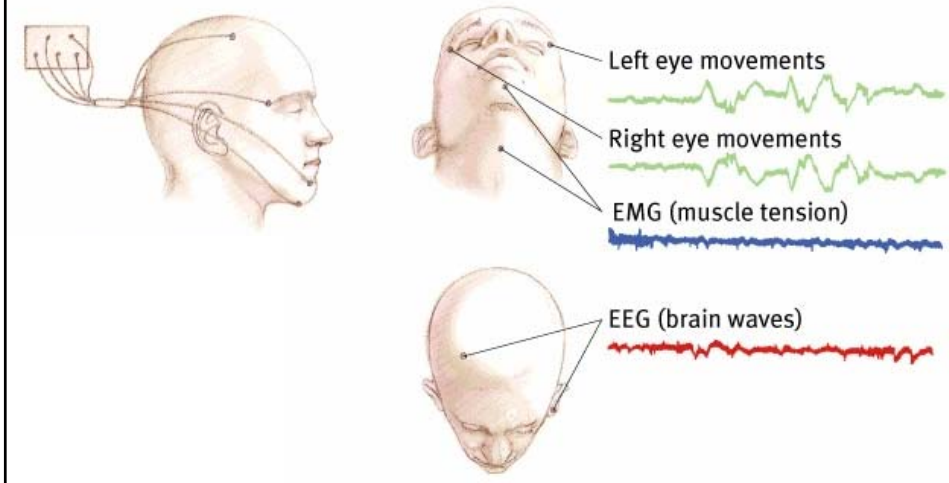
- **Environmental cues – *Zeitgebers*** (ZITE-gay-bers)
- When darkness falls, the eyes indirectly inform the ***pineal glandi*** (responsible for the body's natural cycles and registering light and darkness).
- The pineal glandi secretes the hormone ***melatonin*** in response to darkness, making us drowsy. This affects the brain cells which produce ***Serotonin***, a sleep-related transmitter substance.
- The serotonin is concentrated in the ***Raphe Nuclei*** (near the ***pons***), which secrete a substance that acts to induce light sleep.

Brain structures involved in Sleep

- Cerebrum (cerebral cortex)
- Pineal Gland
- Pons (***Locus coeruleus***)
- Medulla (***Raphé nuclei***)
- Neurotransmitters (***Serotonin, noradrenaline***)



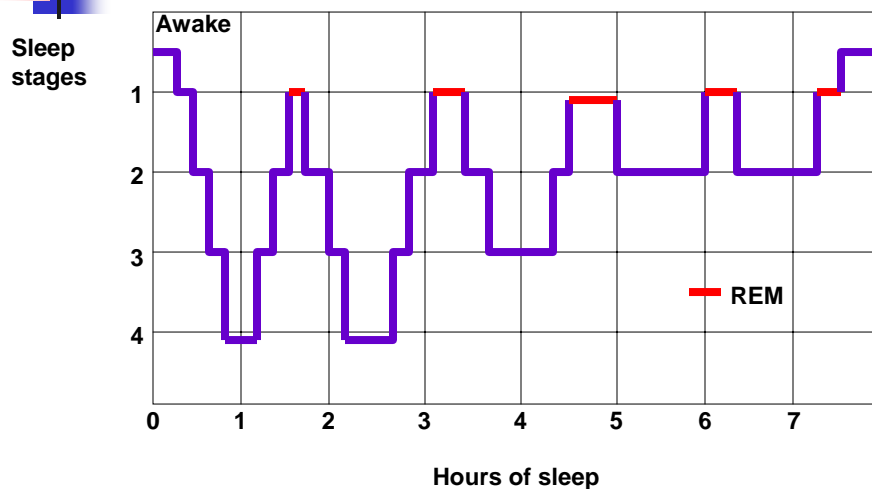
Measuring sleep



Brain Waves and Sleep Stages

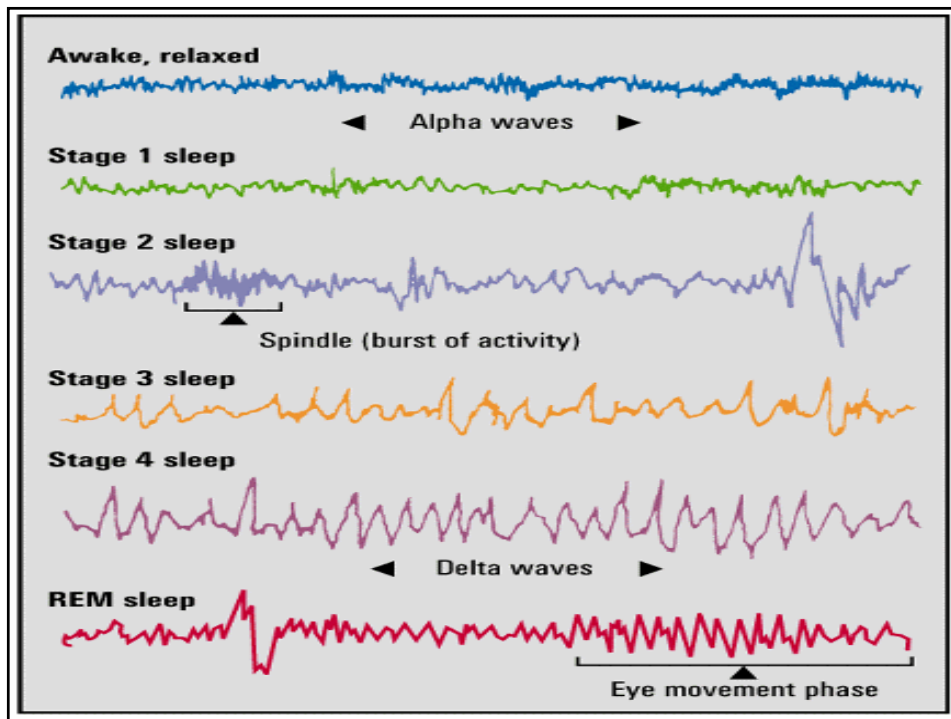
- Delta Waves (1-3 Hz)
 - Large, slow waves of deep sleep, found mainly in infants, sleeping adults, or adults with brain tumours.
- Theta (4–7 Hz)
 - Children aged 2 – 5 years, Psychopaths, frustration, and concentration.
- Alpha Waves (8-13 Hz)
 - Slow waves of a relaxed, awake brain
- Beta (13 Hz+)
 - Adults who are wake, alert, and focused on tasks.

Stages in a Typical Night's Sleep



Stages in a Typical Night's Sleep

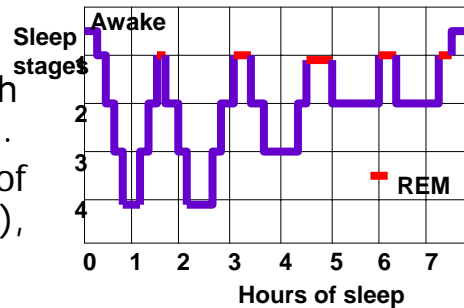
- A typical night's sleep comprises a number of **ultradian** sleep cycles (approx. 90 minutes in duration), each comprising a number of stages :
 - **Stage 1 – Hypogogic period**
 - EEG shows irregular pattern dissimilar from Alpha waves (normally showing relaxed waking state).
 - Alpha waves reduce in frequency replaced by a low voltage (2 – 7 Hz), accompanied by slow rolling eye movements.
 - Heart-rate slows, muscles relax down.
 - Easily disturbed.





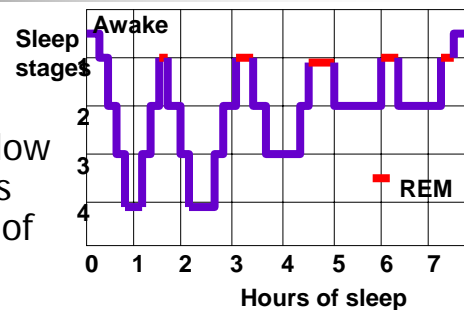
Stages in a Typical Night's Sleep

- **Stage 2**
- Deeper state though still easily disturbed.
- EEG displays burst of activity (13 – 15 Hz), lasting approx. 25 seconds, with occasional sharp rises and falls lasting two seconds on the EEG.



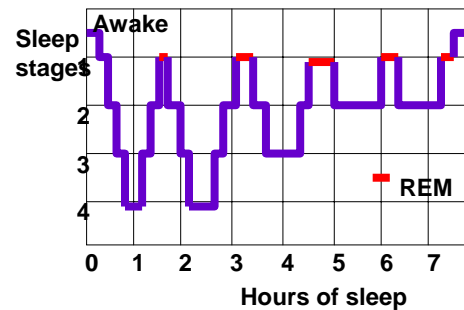
Stages in a Typical Night's Sleep

- **Stage 3**
- Deeper sleep
- EEG activity reduces to slow Delta waves (Delta waves comprising approx. 50% of the record).
- Individual relatively unresponsive to external stimuli
- Heart rate, blood pressure continue to drop.



Stages in a Typical Night's Sleep

- **Stage 4 : Delta sleep / Quite sleep**
- Difficult to wake sleeper.
- Stage 4 may last up to 30 minutes, 1 hour might have passed since stage 1.



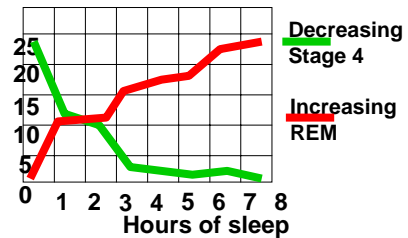
Stages in a Typical Night's Sleep

- **Active sleep**
 - Respiration and blood pressure increases
 - EEG resembles waking state (Beta waves – 13+ Hz)
 - Rapid eye movements (REM)
 - Even harder to wake individual than stage 4.
 - Despite the brain being active, muscles paralysed.
 - ⇒ Movement associated with sleep occurs in stages 1-4 (a.k.a. **NREM sleep** – non-rapid eye movement sleep).



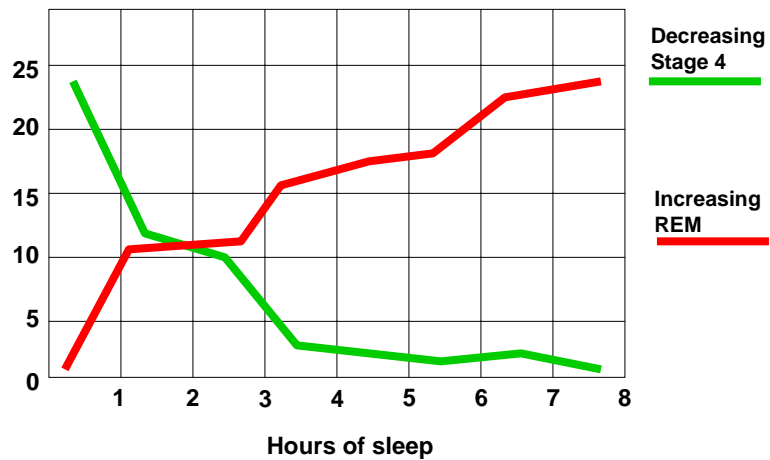
Stages in a Typical Night's Sleep

- After 15 minutes in REM sleep, individual re-enters NREM sleep (stages 2-4), engaging in a further ultradian cycle.
- Further 90 minute cycles characterised by increased REM and shorter NREM.
- Approx. 5 per night depending on sleeping hours.



Stages in a Typical Night's Sleep

Minutes of Stage 4 and REM





Sleep Disorders

- Insomnia
- Narcolepsy
- Sleep Apnea
- Night terrors
- Sleep talking
- Somnambulism (sleepwalking)
- REM behaviour disorder
- Drug withdrawal



Insomnia

- Best know sleep disorder
- Individuals experience persistent problems in falling or staying asleep
- Generally resulting from stress or anxiety.
- However...
 - Kales & Kales (1984) – insomniacs sleep more than they believe they do, based on REM EEG evidence.
 - Participants appeared to have dreamt that they were awake, therefore subjectively feeling tired.



Types of insomnia

- Onset insomnia
 - Difficulty getting to sleep.
- Maintenance insomnia
 - Difficulty remaining asleep, frequent disturbed sleep.
- Termination insomnia
 - Early disturbed sleep, inability to return to sleep.



Narcolepsy

- Uncontrollable sleep attacks.
- Presented by falling asleep unrepentantly during the day.
- Related to intrusion of REM sleep.
- Affecting 1/1000.



Symptoms of Narcolepsy

- Gradual or sudden attacks of sleepiness during the day.
- Cataplexy
 - Sudden muscle weakness and collapsing during waking, often triggered by strong emotions such as laughter, anger, fear or surprise.
 - People with cataplexy prone to injuries.
- Sleep paralysis
 - Inability to move while falling asleep or waking.
- Hypagogic hallucinations
 - Dreaming states at the onset of sleep which the person finds hard to distinguish from wakefulness.



Sleep Apnea

- A respiratory disorder experienced by 10% - 15% of adults.
- Temporary cessation of breathing during sleep, followed by momentary re-awakenings.
- Individuals cease to breathe for approximately 10 seconds waking in panic.



Night Terrors and Nightmares

- Night Terrors
 - Occur within 2 or 3 hours of falling asleep, usually during Stage 4
 - Deep sleep, difficult to wake
 - High arousal - appearance of being terrified
 - Seldom remembered



Sleep talking

- Sleep talking is the utterance of speech or sounds during sleep without awareness of the event.
- Episodes are not associated with awareness of talking
- Polysomnography (sleep recording) shows episodes of sleep talking that can occur in any stage of sleep
- May be associated with psychiatric disorders such as anxiety disorders
- May be associated with medical disorders such as febrile illness (fever)
- May be associated with other sleep disorders such as sleepwalking, obstructive sleep apnea, REM sleep behaviour disorder



Somnambulism (sleepwalking)

- Characterized by walking or other complex behaviours while seemingly still asleep.
- Initiated during REM sleep, a REM behaviour disorder resulting in walking during sleep.
- During this phase, the body releases a chemical that paralyzes the body. However, those who sleepwalk do not have this chemical trigger, hence the behaviour.
- Symptoms and Features:
 - Ambulation (walking or moving about) that occurs during sleep. The onset typically occurs in pre-pubertal children.
 - Difficulty in arousing the patient during an episode
 - Amnesia following an episode
 - Onset of an episode during stage 3 or 4 sleep
 - other medical and psychiatric disorders can be present but do not account for the symptom
 - Fatigue, stress and anxiety
 - Ambulation not due to night terrors.



REM behaviour disorder

- Cataplexy suppressed therefore individuals act out their dreams, perhaps kicking, punching or injuring self/others.
- In animals, disorder associated with damage to the pons and midbrain, where the brain cells inhibiting motor activity are located.



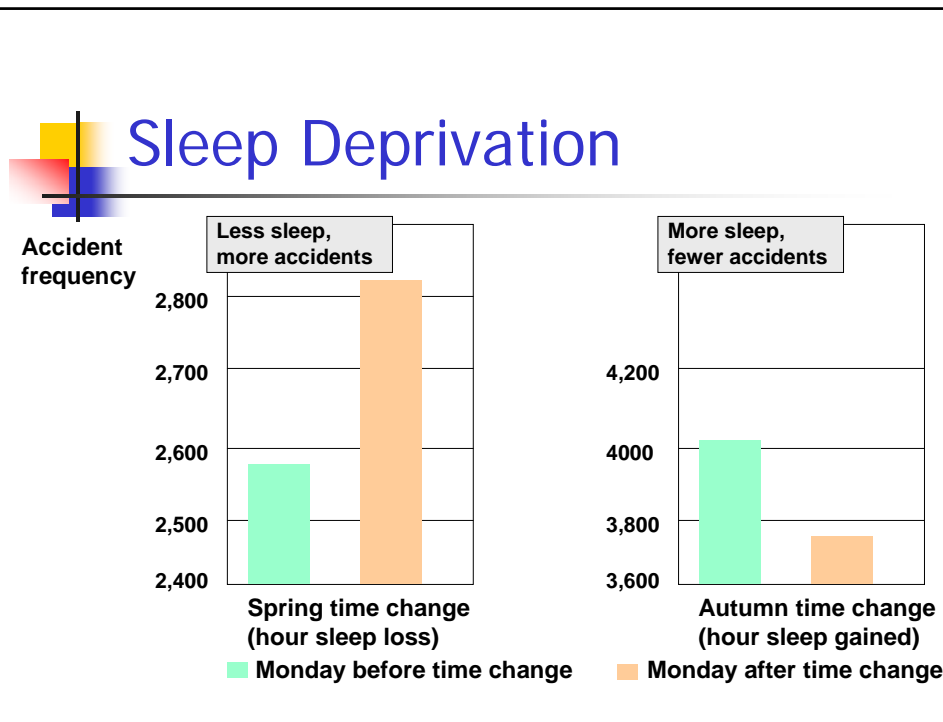
Drug withdrawal

- Drug dependence and withdrawal from Barbiturates and tranquillisers.



Sleep Deprivation

- Effects of Sleep Loss
 - Fatigue
 - Impaired concentration
 - Depressed immune system
 - Irritability
 - Slowed performance
 - Greater vulnerability to accidents



-
- Sleep Deprivation**
- Are You Sleep Deprived?**
1. Need an alarm clock in order to wake up at the appropriate time.
 2. It's a struggle for me to get out of bed in the morning.
 3. Weekday mornings I hit the snooze bar several times to get more sleep.
 4. I feel tired, irritable, and stressed out during the week.
 5. I have trouble concentrating and remembering.
 6. I feel slow with critical thinking, problem solving, and being creative.
 7. I often fall asleep watching TV.
 8. I often fall asleep in boring meetings or lectures or in warm rooms.
 9. I often fall asleep after heavy meals or after a low dose of alcohol.
 10. I often fall asleep while relaxing after dinner.
 11. I often fall asleep within five minutes of getting into bed.
 12. I often feel drowsy while driving.
 13. I often sleep extra hours on weekend mornings.
 14. I often need a nap to get through the day.
 15. I have dark circles around my eyes.



Sleep Deprivation Score

- 4 or less adequate sleep
- 5 or 6 usually adequate sleep-some days may be less, and may mean performance < 100%
- 7 or 8 sleep debt that may cause noticeable reduction in work efficiency
- 9 – 11 a large sleep debt – likely to have large, random errors in work – even large errors may be missed when reviewed
- 12 – 14 person's quality of life suffers – may become a bit accident prone & suffer temporary memory defects
- 15 + sleepiness in range of clinical sleep disturbances – need to increase sleep and seek professional help

Sleeping Through the Night

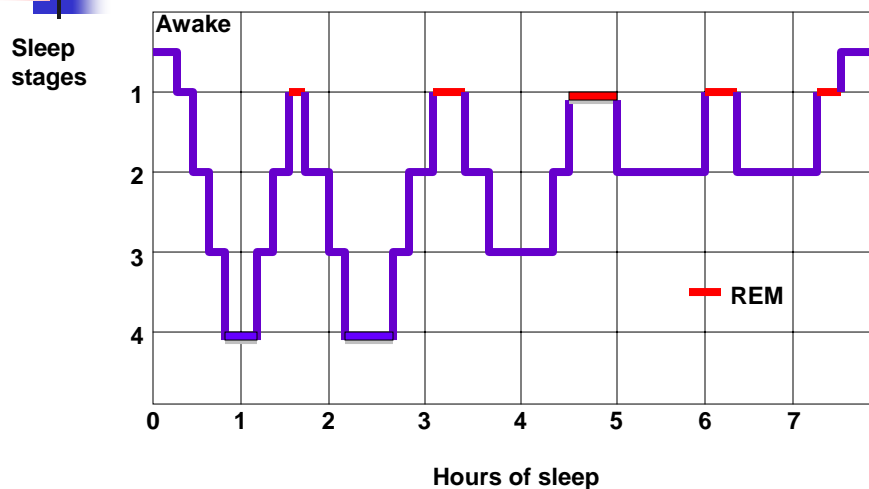
HOW TO DEVELOP GOOD SLEEPING HABITS

1. Go to bed and wake up at the same time every day, including weekends. Establish a routine to help set your biological clock. Changing the time you wake up each day can alter sleep cycles and disrupt other physiological systems.
2. Never have alcohol or caffeine just before going to bed. Alcohol might help you get to sleep more quickly, but it will interfere with your sleep cycle and cause you to wake up early the next day.
3. Regular exercise will help your sleep cycles, but do not do it immediately before going to sleep.
4. Use your bed only for sleeping and sex. Do not spend time in your bed reading, eating, or watching television. You want your mind to associate your bed with sleeping.
5. Relax. Don't worry about the future. Have a warm bath or listen to soothing music. Learning relaxation techniques, such as imagining you are on the beach, with the sun shining on your back and radiating down your hands, may assist in dealing with chronic stress.
6. If you have trouble sleeping, get up and do something else. Don't force yourself to lie there trying to get to sleep. Remember that one sleepless night won't affect your performance very much and worrying about how you will be affected by not sleeping only makes it more difficult to sleep.

Deep Sleep and Dreams

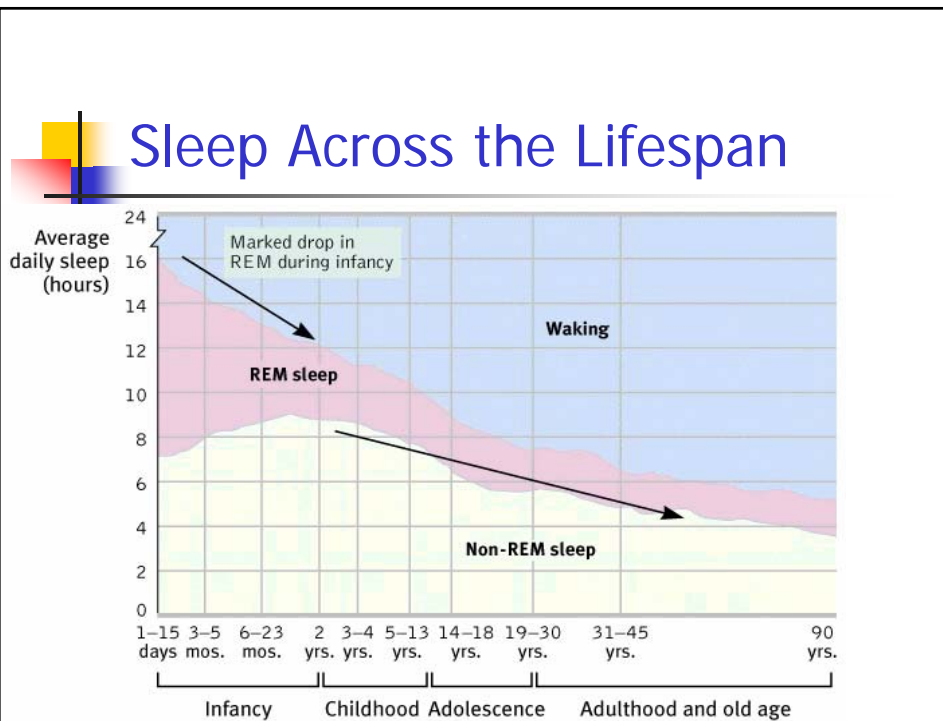
- REM (Rapid Eye Movement) Sleep
 - Recurring sleep stage
 - Characterized by rapid eye movement, vivid dreams, and paralysis
 - Most dreams occur during this stage
 - Brain activity and bodily functions are very similar to those when we are awake
 - a.k.a. "paradoxical sleep"
 - Muscles are generally relaxed, but other body systems are active

Rapid Eye Movements



REM Rebound

- REM sleep increases following REM sleep deprivation
 - Following REM deprivation, we catch up!






Dreams

- Average person has 4-5 dreams per night
- Vast majority occur during REM
- Both internal and external stimuli can modify dreams

- *What* are dreams? Dream theories
 - Wish-fulfilment (Freud)
 - Activation-Synthesis
 - Problem-solving



Daydreams: Adaptive make-believe?

- Daydreams: apparently effortless shifts in attention away from the present and into personal reverie
 - The urge to daydream seems to peak between 12 - 2:00 pm
 - Most common when we'd rather be somewhere else or doing something else
 - Personality can dictate content
 - Can be both adaptive and maladaptive



Why We Dream?

1. Psychoanalytic - Wish Fulfillment
2. Biological basis - Activation
Synthesis
3. Cognitive function – Information
processing



Freud's take on dream 1

- Dreams
 - Sequence of images, emotions, and thoughts passing through a sleeping person's mind
 - Hallucinatory imagery
 - Discontinuities
 - Incongruities
 - Delusional acceptance of the content
 - Difficulties remembering



Freud's take on Dreams 2

- Sigmund Freud--The Interpretation of Dreams (1900)
 - Wish fulfillment - allows discharge otherwise unacceptable feelings
 - Manifest Content
 - Remembered story line of a dream
 - Latent Content
 - Underlying (covert) meaning of a dream



Biological function

- Activation-synthesis theory
 - Random nerve cell firings - periodic brain stimulation
 - Cortical interpretation of random firings



Cognitive Function

- As Information Processing
 - Helps facilitate memories
- REM Rebound
 - REM sleep increases following REM sleep deprivation
 - Following REM deprivation, we catch up!



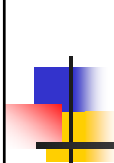
Jet Lag and Shift Work 1

- Due to demands by modern society, circadian rhythms are faced with two disruptions:
 - Jet Lag – Zeitgebers may be accelerated or decelerated depending on time line. Disturbance may last for many days, can take 10 days to adjust to 10 hour time zone change.
 - Shift Work – Zeitgebers remain the same, though natural sleep-wake cycle adjusts.
- ⇒ Result in Circadian disturbance to duration and pattern of sleep, resulting in fatigue, malaise, and deficits to objective tests, physical and cognitive functions.



Jet Lag and Shift Work 2

- However, **Webb** (1995) demonstrated differences in individuals preferences
 - Some individuals perform better in the morning than in the evening and vice-versa
- → Lifestyle was a strong factor.



Psychoactive drugs and consciousness



Psychoactive drugs

- Drugs that influence subjective experience and behaviour by acting on the nervous system.
- A chemical substance that alters perceptions and mood
- 3 major classes:
 - Stimulants
 - Depressants
 - Hallucinogens



Drug-Altered Consciousness

- Stimulants
 - Simulate sympathetic nervous system and produce optimism and energy
 - Caffeine, Cocaine
- Depressants
 - Slow down behaviour & thoughts
 - Alcohol
- Hallucinogens
 - Distort visual and auditory perception
 - LSD (Lysergic Acid Diethylamide), marijuana



How do psychoactive drugs work?

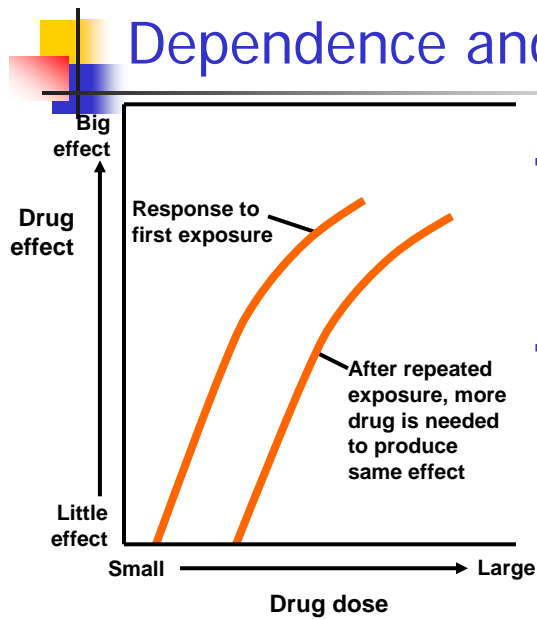
- Once a drug enters the bloodstream, through ingestion, injection, or inhalation, it readily enters the circulatory system of the CNS.
- Alcohol and many of the general anaesthetics, act diffusely on neural membranes throughout the CNS. Others act in less general ways, by :
 - Binding to particular synaptic receptors.
 - Influencing the synthesis, transport, release, and deactivation of particular neurotransmitters
 - Influencing the chain of chemical reactions elicited in postsynaptic neurons by the activation of their synaptic receptors.



Drugs and Consciousness

- Physical Dependence
 - A physiological need for a drug marked by:
 - Unpleasant withdrawal symptoms
 - Tolerance
- Psychological Dependence
 - A psychological need to use a drug
 - E.g. to relieve negative emotions

Dependence and Addiction



- Tolerance
 - diminishing effect with regular use of same dose
- Withdrawal
 - Physical discomfort and distress that follow discontinued use of an addictive drug

Psychoactive Drugs

- Sedatives and Depressants
 - Drugs that reduce neural activity and slow body functions
 - Alcohol, barbiturates, opiates, marijuana, valium



Psychoactive Drugs

- Alcohol
 - affects motor skills, judgment, and memory
 - reduces self awareness
- Barbiturates
 - drugs that depress the activity of the central nervous system, reducing anxiety but impairing memory and judgment

TABLE 4-1

THE BEHAVIORAL EFFECTS OF BLOOD-ALCOHOL LEVELS

Levels of Alcohol in the Blood	Behavioral Effects
0.05%	Feels good; less alert
0.10%	Slower to react; less cautious
0.15%	Reaction time much slower
0.20%	Sensory-motor abilities suppressed
0.25%	Staggering (motor abilities severely impaired); perception is limited as well
0.30%	Semistupor
0.35%	Level for anesthesia; death is possible
0.40%	Death is likely (usually as a result of respiratory failure)

Source: Data from *Drugs, Society, and Human Behavior* (3 ed.) by Oakley Ray, 1963, St. Louis The C.V. Mosby Co.



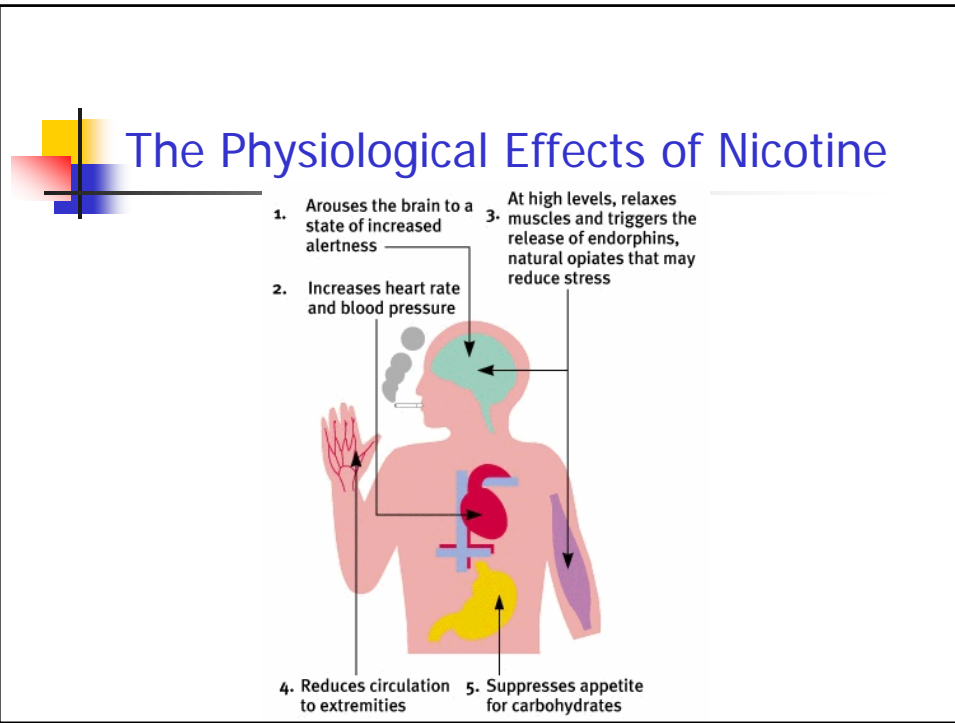
Psychoactive Drugs

- Opiates and narcotics
 - Pain killers
 - Opium and its derivatives (morphine and heroin)
 - Opiates depress neural activity, temporarily lessening pain and anxiety
 - Highly addictive



Psychoactive Drugs

- Stimulants
 - Drugs that excite neural activity
 - caffeine, nicotine, amphetamines, cocaine
 - Speed up body functions



- ## Psychoactive Drugs
- Amphetamines
 - Drugs that stimulate neural activity, causing speeded-up body functions
 - Associated with increase of energy and mood changes



Psychoactive Drugs

- Cocaine
 - Effects depend on dosage, form, expectations, personality and situation
 - coca leaves
 - powder
 - crack



Psychoactive Drugs

- Ecstasy
 - MDMA (methylenedioxymethamphetamine)
 - Stimulant and mild hallucinogen
 - Dangerous short and long term effects



Psychoactive Drugs

- Hallucinogens
 - Psychedelic (mind-manifesting) drugs that distort perceptions and evoke sensory images in the absence of sensory input
 - LSD
 - MDMA (Ecstasy)
 - Mescaline



Psychoactive Drugs

- LSD
 - Lysergic Acid Diethylamide
 - A powerful hallucinogenic drug
 - AKA acid
- THC
 - The major active ingredient in marijuana
 - Triggers a variety of effects, including mild hallucinations

Psychoactive Drugs

Drug	Type	Pleasurable Effects	Adverse Effects
Alcohol	Depressant	Initial high followed by relaxation and disinhibition	Depression, memory loss, organ damage, impaired reactions
Heroin	Depressant	Rush of euphoria, relief from pain	Depressed physiology, agonizing withdrawal
Caffeine	Stimulant	Increased alertness and wakefulness	Anxiety, restlessness, and insomnia in high doses; uncomfortable withdrawal
Methamphetamine	Stimulant	Euphoria, alertness, energy	Irritability, insomnia, hypertension, seizures
Cocaine	Stimulant	Rush of euphoria, confidence, energy	Cardiovascular stress, suspiciousness, depressive crash
Nicotine	Stimulant	Arousal and relaxation, sense of well-being	Heart disease, cancer (from tars)
Marijuana	Mild hallucinogen	Enhanced sensation, pain relief, distortion of time, relaxation	Lowered sex hormones, disrupted memory, lung damage from smoke

Influences on drug use

- Biological / Genetic Influences
- Psychological & Cultural Influences
 - Expectancy effects
 - Peer influences
 - Cross-cultural studies



Hallucinogens



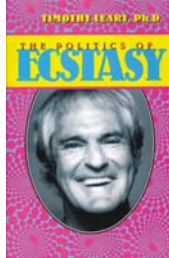
- **Timothy Leary (1965)** – Argued that hallucinogenic drugs allowed the individual to explore areas of consciousness which were not previously accessible.
- Important to take into account :
 - Set – Person's own mental state.
 - Setting – Pleasant and relaxing environment.
 - Lack of consideration for these factors could result in a 'bad trip'



Hallucinogens

- **Leary, Alpert, & Metzner (1965)**
 - Proposed that consciousness involves several distinct layers, and although we use some of these layers in everyday living, others are only accessed by extremes of experience of one from or another.
 - Leary believed hallucinogenic drugs allowed people to access different levels of awareness, as well as mental and physical disciplines involved in yoga and meditation.

References



- Hobson, J.A. (1989) *Sleep*. Scientific American Library, NY.
- Leary, T. (1965, 1998) *The Politics of Ecstasy*. London: Paladin.
- Leary, T., Alpert, R., & Metzner, R. (1965) Rationale of the Mexican psychedelic training centre. In R. Blum (Ed.) *Utopias : the Use and Users of LSD – 25*. London: Tavistock
- Parrott, A., Morinan, A., Moss, M. & Scholey, A. (2004). *Understanding Drugs and Behaviour*. N.Y.: Wiley.

Internet links

- <http://www.uwsp.edu/acad/psych/tdrugs.htm> - Articles, links, topics and laws regarding the use of drugs and their effects upon the brain.
- <http://www.ASDreams.org/> - Pure and applied investigation of dreams and dreaming.
- <http://DreamNetwork.net> - Links to dream, sleep, and consciousness
- <http://www.u.arizona.edu/~chalmers/online.html> - links on consciousness in philosophy, psychology, and other areas.



Review questions

- Do you think your life could be improved by changing when or how long you sleep each day? In what ways? What negative effects do you think such changes might have on you?
- Can it be argued that the Circadian rhythm is learnt as a result of environmental experience?
- What are the main methods which have been used to study consciousness?
- How can the actions of drugs be understood in terms of physiological brain processes?
- Critically evaluate experimental evidence for, and against, theories of dreaming.



Further background reading

- Sleep and REM :
 - The Restoration Theory (a.k.a. Recuperation theories)
 - The Evolutionary Theory (a.k.a. Circadian theories)
 - Animals and REM sleep (Australian marsupial / Dolphin)
 - Sleep deprivation
 - Sleep and accidents
- Psychoactive drugs :
 - Mechanisms of psychoactive drugs
 - Neurotransmitters involved in psychoactive drugs