Chapter highlights – Sleep (Ch 6)

The purpose of “chapter highlights” is to offer a framework in which to think about the specific information discussed in each Brain Facts chapter. These highlights draw upon information in the chapter and on the new Brain Facts web site (http://www.brainfacts.org) and occasionally, on our own knowledge of neuroscience that may not be discussed in Brain Facts. Questions for Brain Bee will come from Brain Facts (new 2012 publication) and entries from the new Brain Facts web site that have “brainfacts.org” in the URL. Some but not all relevant entries are cited below.

Sleep http://www.brainfacts.org/sensing-thinking-behaving/sleep/

What you should know about sleep: sleep matters!!

- Lack of sleep impairs cognitive and motor function and increases risk for disease
  - Can have deleterious effects that are worse than alcohol
- Sleep disorders http://www.brainfacts.org/sensing-thinking-behaving/sleep/articles/2012/sleep-disorders/
  - Are common but tend to go unrecognized and undiagnosed
  - High economic cost to our nation
  - Sleeping pills can help individuals to sleep but drug-induced sleep does not mimic the natural sleep cycle
    - Outcome: individuals may not feel comparably rested for the increased time spent sleeping
  - Chronic decrease in deep slow wave sleep is associated with increased risk for disease
  - While the cause behind many sleep disorders is poorly understood, the cause behind some sleep disorders like narcolepsy and sleep apnea are known http://www.brainfacts.org/sensing-thinking-behaving/sleep/articles/2012/narcolepsy/; http://www.brainfacts.org/diseases-disorders/diseases-a-to-z-from-ninds/sleep-apnea/
- EEG (electroencephalography) is a technique used to monitor brain activity during sleep http://www.brainfacts.org/sensing-thinking-behaving/sleep/articles/2012/brain-activity-during-sleep/
  - Based on the pattern of brain waves observed in the EEG recordings, sleep can be divided into distinct stages: REM (rapid eye movement) sleep and non-REM sleep (also known as slow wave sleep) http://www.brainfacts.org/sensing-thinking-behaving/sleep/articles/2012/the-different-kinds-of-sleep/
    - Non-REM sleep is divided into 4 stages
• The amount of sleep and the pattern of sleep change naturally with age
  http://www.brainfacts.org/sensing-thinking-behaving/sleep/articles/2012/the-sleep-cycles-in-a-night/

• Sleep is also accompanied by systematic changes in endogenous hormones, body temperature, heart rate, blood pressure, and motor activity

• The transition from sleep to awake is controlled by coordinated activation and silencing of various brain circuits. http://www.brainfacts.org/sensing-thinking-behaving/sleep/articles/2012/how-is-sleep-regulated/

• Two factors regulate sleepiness: the circadian system (time of day or night) and homeostatic system http://www.brainfacts.org/sensing-thinking-behaving/sleep/articles/2012/the-sleep-wakefulness-cycle/

  o Circadian system
    • Depending on the time of day, you have a stronger urge to sleep
    • In mammals, circadian regulation is monitored by a small brain region in the hypothalamus, the suprachiasmatic nucleus (SCN).
      • the SCN is the master biological clock and regulates wake/sleep states in the brain and regulates the daily rhythms in the function of other organs in the body
      • activity of the SCN is influenced by light information from the eye
      • consistent daily changes in light levels entrain the brain to “sleep” during the dark phase of the day and to be “awake” during the light phase of the day
        • animals active during the light phase and inactive during the dark phase are diurnal
      • exception: some animals are active during the dark phase and sleep during the light; they are nocturnal. In these animals, the brain interprets light information differently, instructing the brain to sleep during the light phase and be awake during the dark.

  o Homeostatic system
    • The longer you are awake, the stronger urge you have to sleep
• Accumulation of the neurochemical adenosine occurs with prolonged wakefulness. Higher levels of adenosine decrease arousal and sleep serves to decrease adenosine levels.

• While numerous neurotransmitter systems are involved in regulating sleep, differential activation of two major pathways encodes REM sleep vs. awake
  • cholinergic and monoaminergic pathways
  • orexin is an important signal for keeping the brain “awake”, possibly by activating the monoaminergic pathway