SLEEPING
one of the most important things in your life

SPRING 2012 BE LAB
MAY 2 2012

電機三 b98901002 張恆律
電機三 b98901058 李啟瑞
電機三 b98901147 吳懷哲
OUTLINE

• Basic physiology of sleeping
• Factors affecting the sleeping quality
• How can technology help us sleep better?
SLEEPING CYCLES

BASIC SLEEPING PHYSIOLOGY
Sleeping cycles

- Separate by electroencephalography (EEG) features.
- Rapid eye movement (REM)
- Non-rapid eye movement (NREM)
- Average 90 mins/cycle
- 5 cycles/night
  - less deep sleep and more REM.
- Compensate effect
4 stages of NREM

• Stage 1: Alpha waves.
• Stage 2: Theta waves.
• Stage 3&4: Delta waves.
Stage 1 of NREM sleep

- Alpha waves (8~13Hz) are predominant.
- Transition stage when falling asleep.
- Experience hypnagogic hallucinations.
  e.g. Hypnic jerk
  felling of falling
Stage 2 of NREM sleep

• Start of true sleep
• Theta waves (4~7Hz) are predominant.
• Conscious awareness of the external environment disappears.
• Sleep spindles and K-complexes.

![Waveform diagram showing sleep spindles and K-complexes.](image)
Stage 3 & 4 of NREM sleep

- Slow wave sleep.
- Delta waves (0.5~2Hz) are predominate.
- Movement is still possible.
- Sleep walking.
REM sleep

- Also called active sleep.
- Eyes turns back and forth.
- Rapid low-voltage EEG.
- Muscle activity suppressed.
- Dreaming.
Why do we need to sleep?

- Restoration theory: sleep promotes physiological processes that rejuvenate the body.
- Evolutionary theory: sleep emerge in revolution to preserve energy and preventing a particular species to interact with the environment.
CAN WE SLEEP BETTER?

SLEEPING QUALITY
How come we sleep badly?

• Environment factors
  – Noise
  – Moisture
  – Temperature

• Metabolism factors
  – Caffeine, alcohol, nicotine....(diet)
  – Lack of regular exercise
Just in time with sleep

• The **RIGHT** time to
  – sleep
    • Conforms to the physiological cycle
  – wake up
    • Conforms to the sleeping cycle
    • The end of REM is best
Light does matter

• Light is a strong signal
• Blue light can stimulate neurotransmitters, tell your brain when to work
Physiological aspects

• Brain disorder
• Anxiety, sadness ...
• Too tired, accumulation of lactic acid
YEAH, IT’S BE LAB THOUGH

HOW COULD MACHINES INVOLVED?
Polysomnography (PSG)

- EEG / EOG / EMG / ECG
- Respiratory patterns
- Body positions
- Oxygenation
- Snoring
- LIFE-SAVING!
  Ex.OSAS
Force sensors

- Static charge sensitive bed (SCSB)
- Air cushion
Apps, why not?

Monitor your movement with the accelerometer. Wake you up at the right time.
References

• Wikipedia - Sleep
• Sleep Cycles
• 全面啟動你的夢境
• 適用於居家環境之睡眠監測技術
• Sleep Cycle Alarm