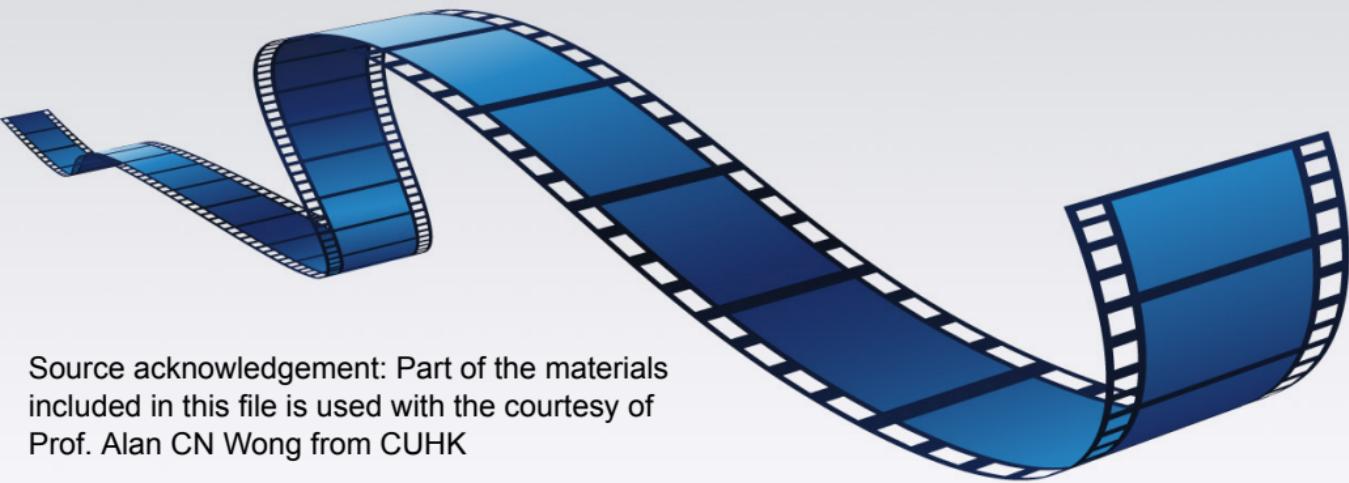


# **Sleep, Dream & Consciousness**

## **Scene II – Action & Adventure**



Source acknowledgement: Part of the materials included in this file is used with the courtesy of Prof. Alan CN Wong from CUHK

# What is Consciousness

- Awareness of things around *voice, sight*
- Subjective, inner feelings
- What it feels like to be me
- Different states, e.g., sleep, dream, meditating...

2007 decade of the Mind



# Topics related to Consciousness

- Sleep
- Dream
- Meditation & Hypnosis
- Drug & Biofeedback
- Attention
- Unconscious perception
- False memory & reconstructed reality
- Implicit memory and learning
- Brain decoding & mind reading
- Artificial intelligence
- Mind-body problem
- Out-of-body experience
- Free will & determinism...



# Sleep and Dream



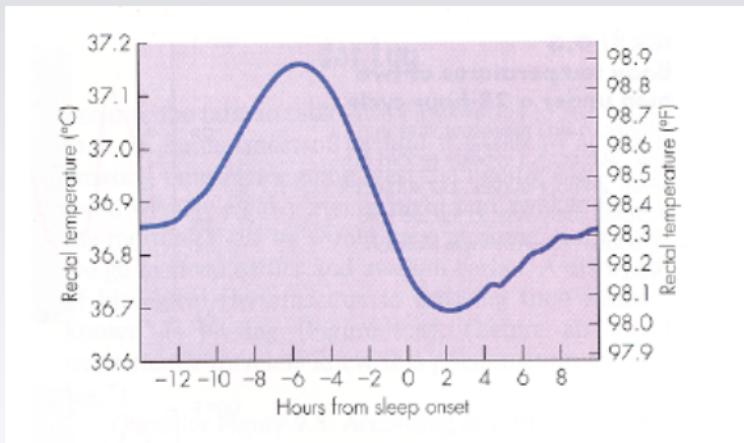
# Questions you may have...

- Why am I so sleepy now?
- Why are some of us early persons while others night persons?
- Why do we need to sleep?
- Why do we dream?
- How to keep a regular cycle of wakefulness and sleep?

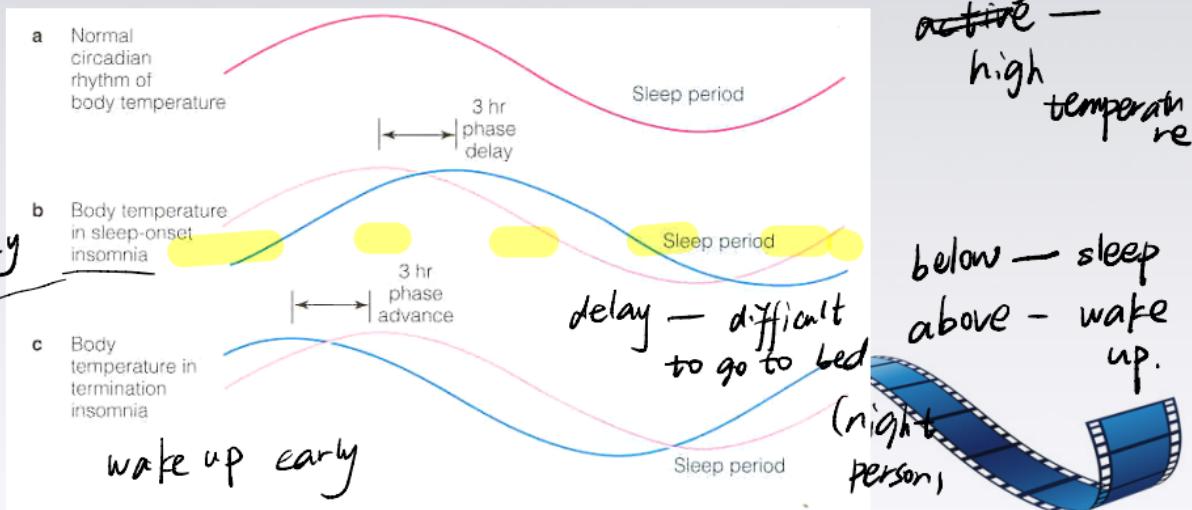


# Circadian rhythm

- Biological processes following approx. a 24-hour cycle (*circa + diem*)
  - Sleep wake cycle
  - Body temperature rhythm (36.7 – 37.2 deg. C)
    - Max at 6pm and min at 2am with a dip after lunch



- Result of metabolic activities
- Cognitive function is also affected
- The two cycles might not be in phase



# Internal biological clock

- French geologist Michel Siffre (1972) lived in a cave of no sunlight for several months.
- A free running circadian rhythm of  $24 \frac{3}{4}$  hours
- Sunlight is crucial in tuning the biological clock into a 24-hr cycle



# Internal biological clock

- The suprachiasmatic nucleus (SCN)
  - Regulates the production of **melatonin** (sleep hormone) by the pineal gland  
褪黑素
  - The internal clock comes from SCN's **own rhythm**
    - Daylight fades -> SCN -> pineal gland (release melatonin) -> melatonin -> sleepy
    - Daylight starts -> SCN -> pineal gland (stop releasing melatonin) -> melatonin -> awake

内部生物鐘



# External control of SCN

- Strong sunlight can stimulate SCN to stop melatonin production
- Taking melatonin can affect the cycle
- Since our internal clock has a natural cycle of 24+ hours, it is easier to adopt a longer artificial circadian cycle (e.g., 25 hrs) than a shorter one (e.g., 22 hrs)
  - Easier to overcome jet-lag when going west than going east



# Sleep stages

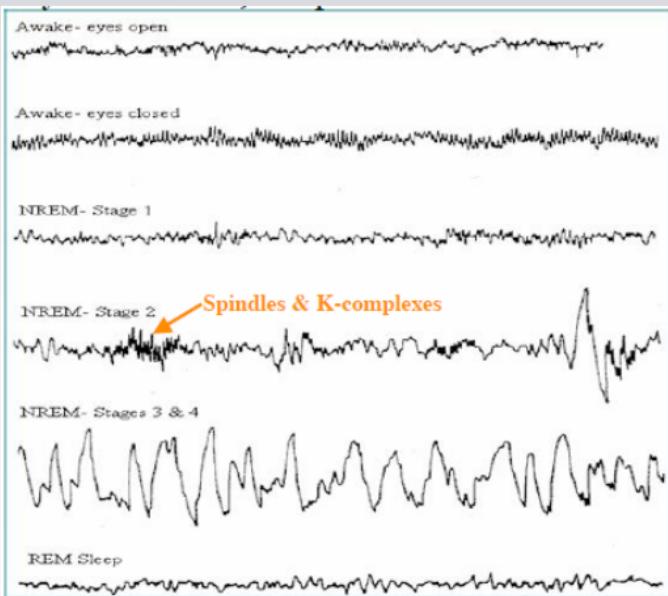
睡眠阶段.

- Method of study -> Brain EEG waves
- EEG -> Electro-encephalograph



# Sleep stages

- Different brain EEG waves in different stages
  - Stages 1-4: Non-REM sleep
  - Stage 5: REM (**rapid-eye movement**) sleep



Alert: Beta waves

Relaxed: Alpha waves

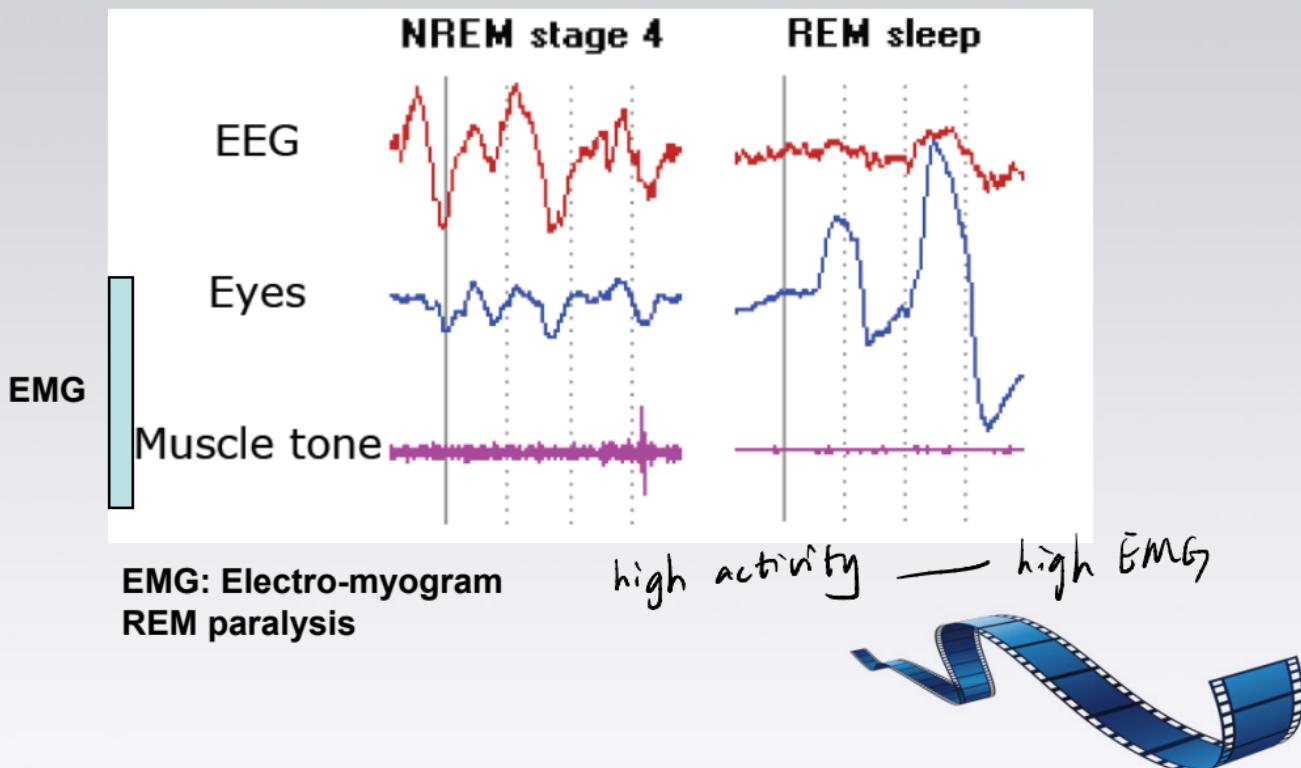
Shallow sleep: Theta waves

amplitude bigger  
frequency lower

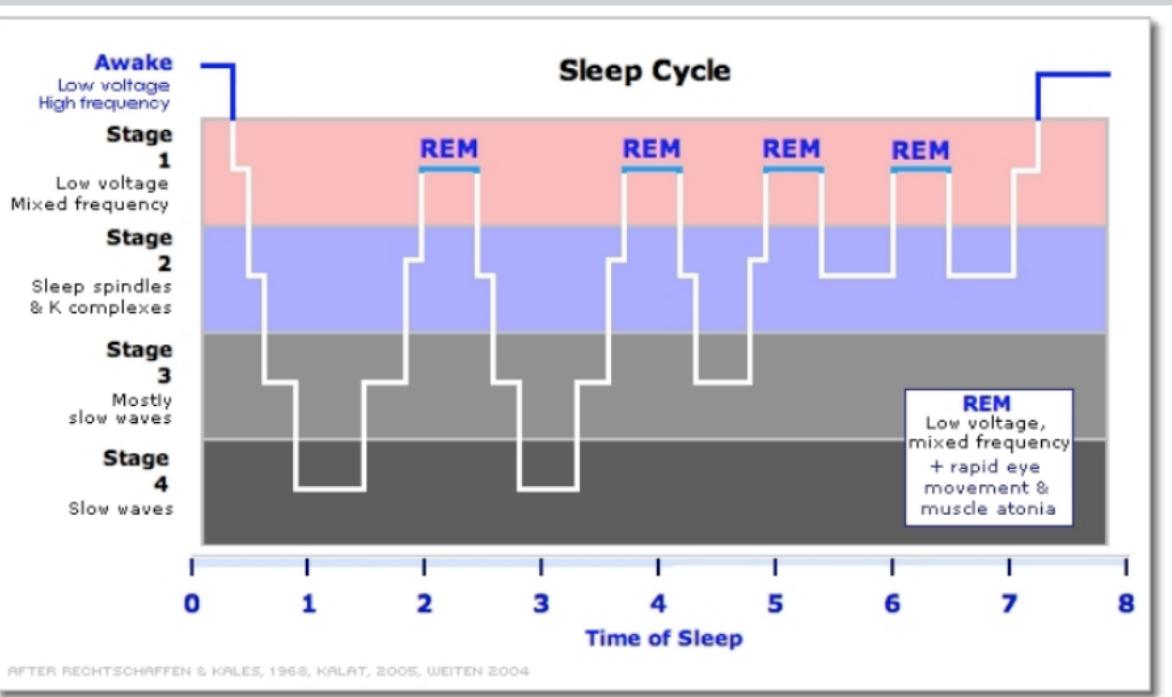
Deep sleep: Delta waves



# Sleep stages



# Sleep stages



# Sleep stages

- A cycle of NREM and REM ~90 mins
- Each REM sleep last about 5 to 30 mins
- How can you tell when someone is having REM sleep?
  - Disorganized EEG pattern as if the person is awake
  - Rapid eye movement
  - Decrease in muscle tone (i.e. the major muscles are paralyzed; REM paralysis)
- Differences between adults and infants
- REM sleep occurs more frequently as sleep progresses



# Go without sleep?

- Almost 11 days – 16 years old Randy Gardner (1965)
- 11 days – Tony Wright (2007)
- Some short-term effects (e.g., poor in concentration, motivation, perception, and cognitive functioning) (Van Dongen et al., 2003)
- Sleep study: No sleep, 4 hrs, 6 hrs, 8 hrs (3 days)
- Little long-term effects?



# Theories of Sleep

- Adaptive theory of sleep
- Restorative theory of sleep



# **Adaptive theory of sleep**

- Sleep -> a product of evolution
- Avoid being present in the predators' hunting times (night times)
- Longer sleeping times for predators



# Repair and restoration theory of sleep

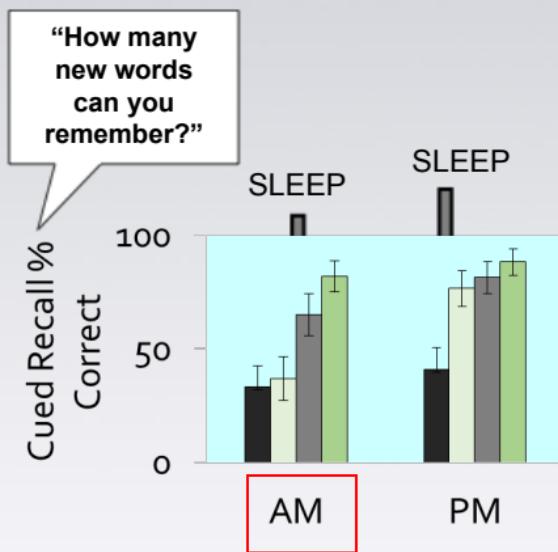
- Sleep is a biological necessity for repair and restoration.
- Deprived sleep increases slow wave sleep.  
*导致慢波睡眠增加*
- Vigorous exercises (high wear and tear) results in longer slow wave sleep.  
*导致慢波睡眠增加*
- Consolidation hypothesis. An increase in REM is related to heavy memory load (or emotional stress (Horne & Staff, 1983)) and emotional experiences  
*导致慢波睡眠增加*
- Sleep is associated with learning new vocabulary\*\*\*  
(Henderson et al., 2012; *Developmental Science*)



# Lisa-Marie Henderson

## *Consolidation of Learning During Sleep*

Sleep strengthens memories for new words in children (7-12 years)



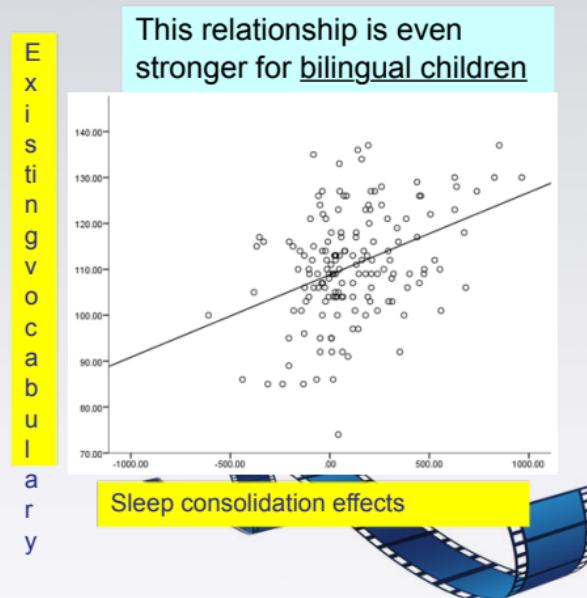
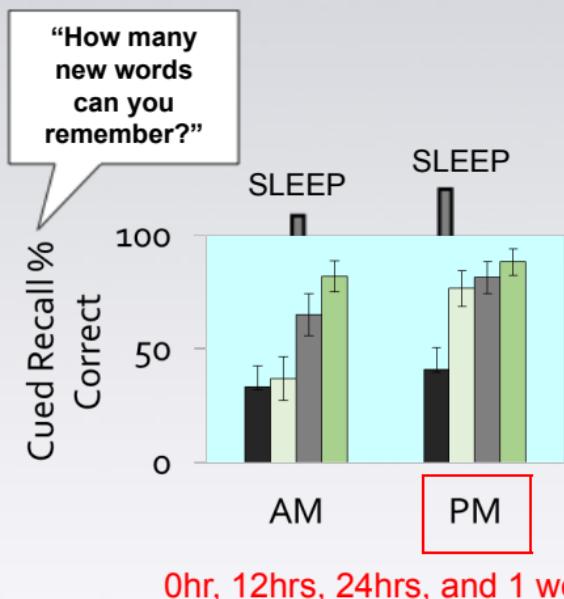
0hr, 12hrs, 24hrs, and 1 week after



# Lisa-Marie Henderson

## *Consolidation of Learning During Sleep*

Sleep strengthens memories for new words in children (7-12 years)



# Dream

- A subjective experience involving complex, organized mental images with temporal progression.
- In sleep onset, dream-like imagery may appear. Some experience falling.
- When wakened from REM sleep, 79% of people report dreaming (c.f. 9% for non-REM sleep).
- Vivid imagery
  - 68% with color.
  - 94% with speech.
  - 13% with non-verbal sounds.
  - 1% with touch, taste, or smell.
- Later in the night, dreams contain more verbal activity and are better recalled.



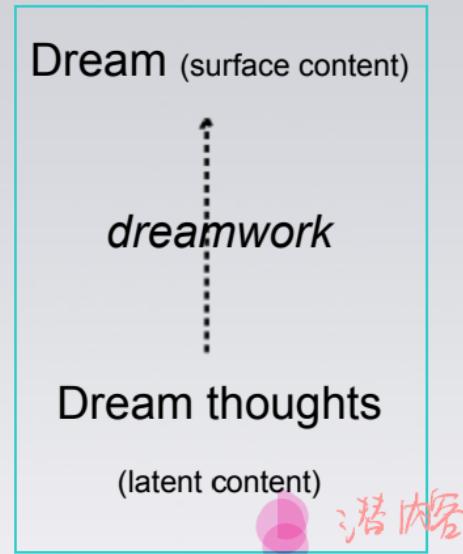
# Why do we dream?

- Three types of theories
  - Freudian theory of discharge of unconscious desire
  - Neurophysiology-cognitive
    - Activation-synthesis theory of Hobson & McCarley
    - Cognitive theory of Foulkes
  - Problem solving theory (Breger and Hartmann)



## a) Freud's theory

- Freud - The Interpretation of Dream (1900).
- Dream is a method to discharge the anxiety created by forbidden desires
- The latent content is the dream thought
- The conscious surface content is a symbol of dream thoughts modified by dreamwork so that they can be disguised to preserve sleep.



- “Boxes, cases, chests, cupboards and ovens represent the uterus, and also hollow objects, ships, and vessels of all kinds. Rooms in dreams are usually women; if the various ways in and out of them are represented, this interpretation is scarcely open to doubt ... A dream of going through a suite of rooms is a brothel or harem dream ... It is highly probable that all complicated machinery and apparatus occurring in dreams stand for the genitals (and as a rule male ones)...”
- (Freud, 1900/1965, pp. 389-391)



# Evaluation

- Freud's dream theory is not scientific
  - The transformation is not well specified
  - What if different groups of psychologists get together to interpret a single dream? Will they come up with the same interpretation?
- No explanation about animals and fetus before birth having dream states



## b) The Activation-synthesis model

- Before Freud, Wundt worked in the area of dream. Wundt predicted that in dream, some areas are over excited and some inhibited.
- Hobson and McCareley's activation-synthesis model involving the **activation** of the various brain areas and the **synthesis** into a story.
- According to Foulkes (1985), dreams are involuntary thinking during sleep.



combination random  
part

corporate dream level and  
reality level

- Dreams are byproducts of neurological events in REM sleep
- About activation, parts of the brainstem (pons) send random signals to activate/inhibit various brain areas.
  - The limbic system related to emotion.
  - The motor area for movement.
  - The various sensory areas (visual, auditory, etc.).
- Frontal part of the brain is inhibited
- About synthesis, the brain makes up a story based on the excited elements in the cortex (Including the feedback from the autonomic nervous activity, eye movement, and direct stimulation in the period of dreaming (e.g., feedback of leg not moving, alarm clock...).

internal + external



# Dream characteristics explained

- The random activation of the various brain areas in dream is similar to the activation of neurons in everyday life perception -> *delusional acceptance*
- Sometimes the internal and external stimulations are combined.
- Sometimes dreams are bizarre in some sense
  - The spatial-temporal pattern of different stimulations (emotion, movement, sensations) may be different from that in real life
  - The loss of music tones.
  - Reading difficulties...
- The poor recall in dream is due to the decreases in neuronal activity in memory-encoding circuits during REM sleep.



# Evaluation

- How to explain dreams occurring in NREM states?
- In some cases dreams are meaningful
- Too much emphasis on sensory/perceptual aspects
  - Activation may involve the memory of an event, a concept, or a problem rather than just sensory elements -> activation-information mode model (AIM) (Hobson et al., 2000)



### c) The Problem Solving Theory

- Dreaming serves to process emotional information
    - Close relationship between emotion in narcolepsy disorder
    - People with traumatic experience have dreams related to the disaster event producing nightmares
  - Negative emotions are solved near the morning
    - Dreams in the later part of sleep tend to be happier than those in the earlier part
  - New emotional experiences are organized into thinking frameworks that have been effective in handling such experiences in the past
  - Evaluation: Could not explain weirdness of dreams.

continues to work. does not stop.



# Summary

- Sleep and circadian cycle is due to an internal timer. The interplay between Suprachiasmatic Nucleus (SCN) and melatonin in pineal gland is the neural basis of the circadian cycle. The internal timer, however, can be modified by external stimulations like daylight.
- Sleep is active and we have a number of stages in sleep-dream.
- No single dream theory seems to satisfactorily explain all phenomena associated with dreaming.

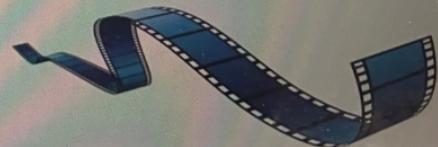


*being able to aware you're dreaming*

# Lucid dream

*become more sensitive.*

- Rate can be improved by training
- 1) Practice **dream recall** (e.g., write dream diary) -> increase your sensitivity towards dream contents -> spot frequently occurred dream elements (*dreamsigns*)
  - Dreams signs can be something related to your daily life context (e.g., classroom, corridor...)
- 2) During waking hours, always **ask yourself** “if you are dreaming” (best if you ask this question in places associated with the dreams signs)



# Lucid dream

- 3) **Visualize** the dreamsigns when awake and tell yourself that whenever a dreamsign is seen again you are having a dream



# Lucid dream

- 3) **Visualize** the dreamsigns when awake and tell yourself that whenever a dreamsign is seen again you are having a dream



# Dreaming and Movie watching

- Are they similar, are they not?

prefer to watch in evening

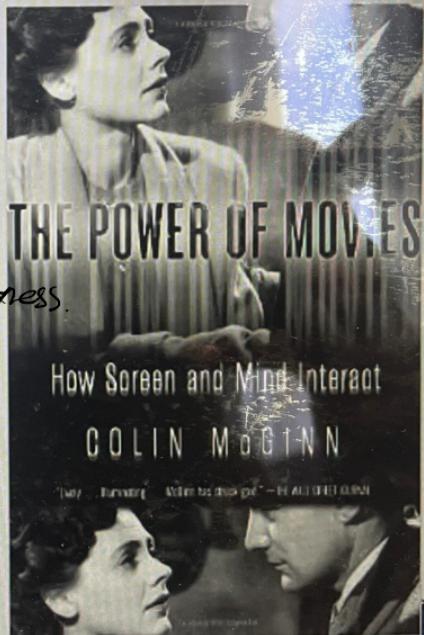
Movie:  
The way complicated  
without consciousness.

combine scene together  
make sense.

do not need to teach

~~any~~ built-in

dream made our  
be able to understand  
relation to of REM sleep



combine  
REM  
together  
5 ~ 20 mins  
→ 5  
2 hours  
purely  
REM  
for dreaming  
shape our  
preference

