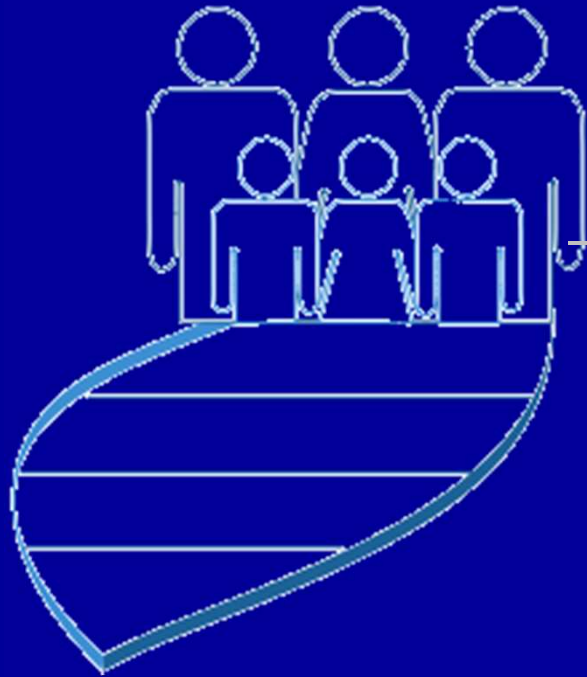


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The Science of Sleep

Tina Locke

Sleep Patterns

Weekdays:

- What time do you go to bed?
- What time do you wake up?

Weekend days:

- What time do you go to bed?
- What time do you wake up?

Do you think you get enough sleep?

Question # 8

Sleep is a time for the body and brain to shut down for rest.

Disagree

Sleep is a dynamic process:

- ❖ Some increased brain activity
- ❖ Endocrine systems increases secretions of certain hormones

[What is sleep video](#)

Question # 6

Most teens need at least nine hours of sleep each night.

Agree

- Teens do need at least 9 hours of sleep per night
- Teens need more sleep than adults
- Most teens do not get enough sleep

Why is sleep important?

- Memory
- Concentration
- Motor response/reaction
- Controlling emotions
- School/work/athletic performance

Sleep Regulation

Sleep variables:

- Duration
- Sleep intensity

Regulated by:

- Circadian system
(Biological clock)
- Homeostatic
mechanism

(Tobler and Achermann)

Sleep Cycles

1. Biological clock – when
2. NREM/REM – how
3. Sleep Homeostasis - need

Question #1

Everyone has a biological clock.

True

➤ The timing of sleep in humans is regulated by our biological clock

(1) Biological Clock

- Cycle: a little longer than 24 hour period
 - “CIRCADIAN CLOCK”
 - circa=about
 - diem=day
- Clock Regulates:
 - Seasonal reproductive cycles
 - Sleep/wake cycles
- External and internal rhythms.

Question # 9

The body quickly adjusts to different sleep schedules?

False

- Circadian clock works on day/night schedule, despite attempts to change it
- Clock can sometimes be reset, but only by an hour or two.

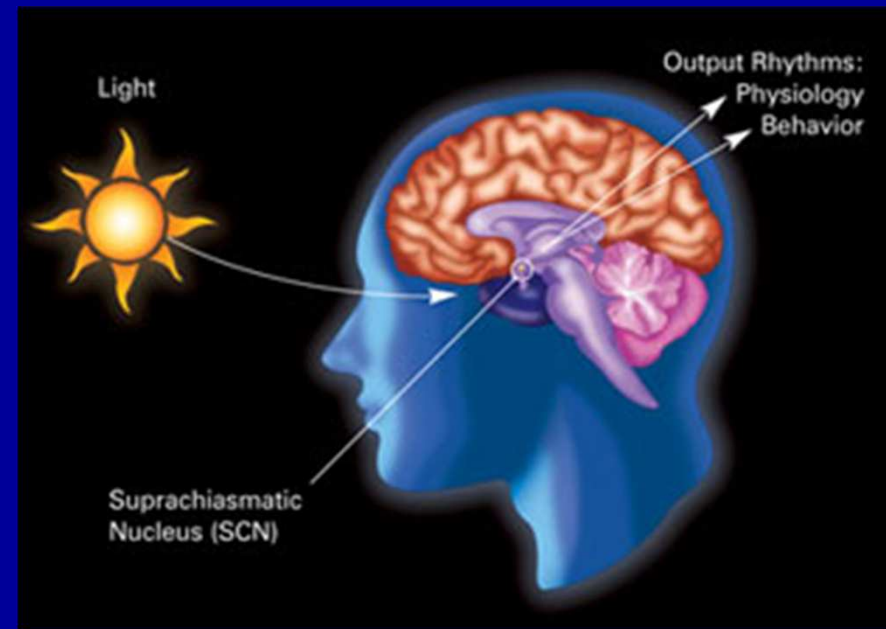
Circadian Rhythms

Two Clock Rhythms

- External (environmental) rhythm
- Internal rhythm

External rhythm LIGHT

- Clock location:
suprachiasmatic nucleus
(SCN) of the hypothalamus
in the brain
- At SCN signals interact
with genes (active/inactive)
to serve as “pacemakers”



http://en.wikipedia.org/wiki/File:Circadian_rhythm_labeled.jpg

Internal rhythm

- Rhythm continues in absence of environmental cues
- Cycles just over 24 hours, bedtime 1 hour later each night.
- 24 days back to same bedtime.

[Biological Clock Video](#)

(2) NREM/REM (Ultradian Rhythm)

- Slow wave - Non Rapid Eye Movement (NREM)
- Rapid Eye Movement (REM)

NREM

- Slow wave
 - Low muscle movement
 - Limited eye movement
- Brain distributes information into networks & categories. (FRONTLINE)
- Connections between nerve cells strengthen - consolidating new skills. (FRONTLINE)

REM

- REM
 - Burst of rapid eye movement
 - Almost paralyzed
- Brain re-enacts previous day (FRONTLINE)
- Solidifies newly made connections through memory banks (FRONTLINE)

(2) NREM/REM

Practice makes perfect!!

NovStep Mo

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(3) Sleep Homeostasis (Homeostatic “rhythm”)

Homeostasis: maintaining internal equilibrium by adjusting internal processes

- Sleep pressure increases when awake
- Sleep pressure decreases during sleep

Sleep Homeostasis

➤ Molecule Adenosine:

- Keep tracks of sleep loss
- May induce sleep

Caffeine binds and blocks receptors

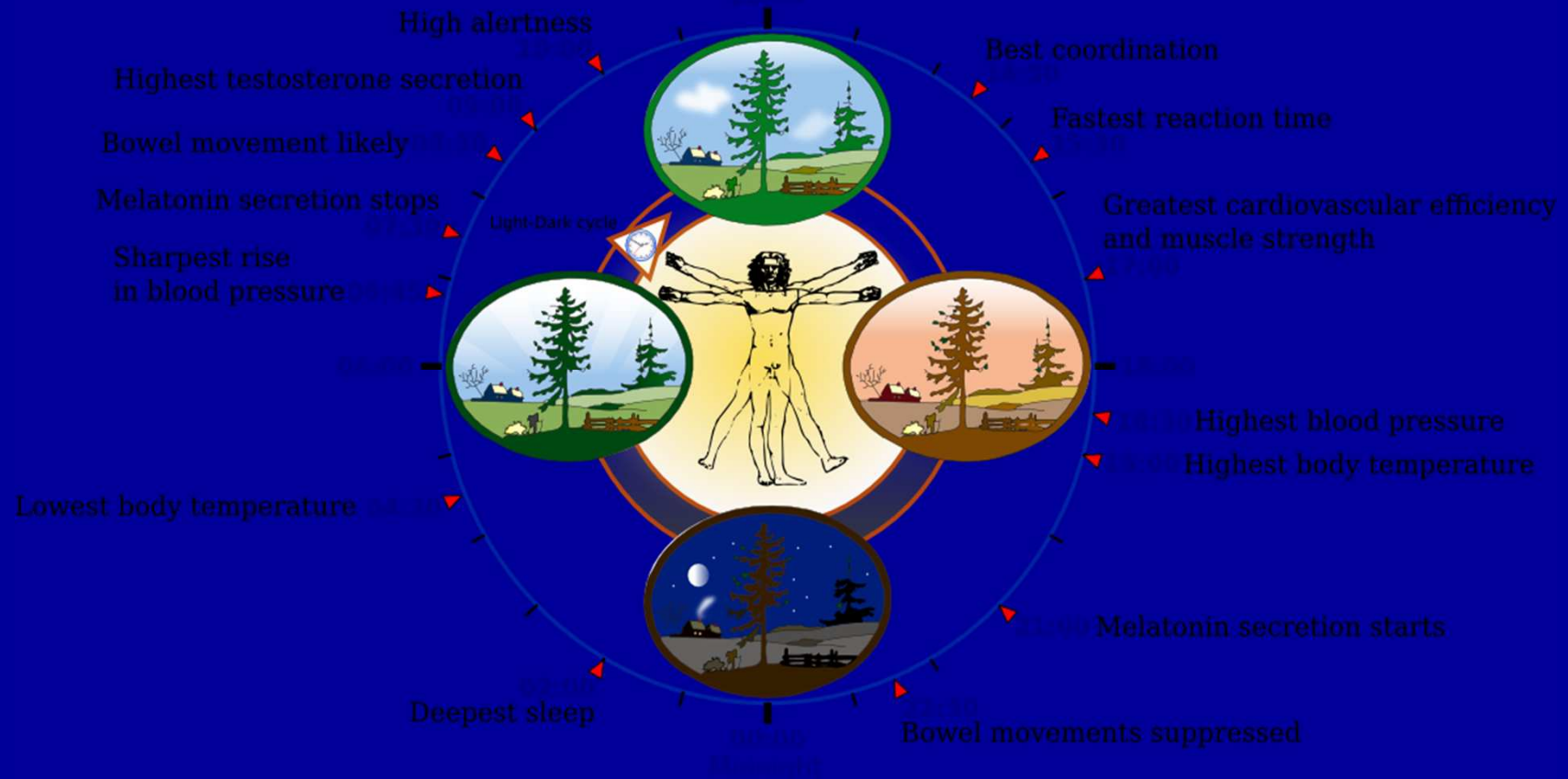
➤ Hormone melatonin:

- Levels rise during the night
- Levels decline at dawn

Controlled by the clock

[Sleep Homeostasis Video](#)

Sleep Cycles



Circadian patterns typical of someone who rises early in morning, eats lunch around noon, and sleeps at night (10 p.m.)

http://commons.wikimedia.org/wiki/File:Biological_clock_human.PNG

- 1) Biological Clock - when
- 2) NREM/REM - how
- 3) Homeostasis - need

Why is sleep important?

- Memory
- Concentration
- Motor response/reaction
- Controlling emotions
- School/work/athletic performance

Question #10

Getting one hour less sleep per night than I need will not have any effect on my daytime performance.

False

➤ small, regular, decreases can effect daytime performance.

What are good and bad sleep habits?

Good Sleep Habits

Bad Sleep Habits

What are some consequences of bad sleep habits?

— Individually

Socially

Question #3

Safe drivers don't have to worry about being sleepy?

False

➤ Sleepiness = decrease in alertness

➤ Decrease in alertness \neq safe driving

Question # 7

Driving makes you sleepy.

False

- Driving makes your level of sleepiness apparent
- Safest to drive during alert times

References

Unless otherwise noted within the presentation, information, charts and graphs have been obtained from *NIH Curriculum Supplements for Grades 9-12. Sleep Disorders and Biological Rhythms*.

1. *NIH Curriculum Supplement Series for Grades 9-12. Sleep Disorders and Biological Rhythms*. National Institutes of Health
<http://science.education.nih.gov/customers.nsf/HSSSleep?OpenForm>
2. FRONTLINE. Adolescents and Sleep, A Summary of What Researchers Know About Teenagers' Need for Sleep and Why Sleep Affects Memory and Learning.
<http://www.pbs.org/wgbh/pages/frontline/shows/teenbrain/from/sleep.html#fnB0>
3. Jenni OG., Achermann P. and Carskadon MA. Homeostatic sleep regulation in adolescents. *SLEEP* 28 (2005) 1446-1454.
4. Tobler, Irene and Achermann, Peter, Sleep homeostasis.http://www.scholarpedia.org/article/Sleep_homeostasis
5. What is Sleep, Biological Clock and Homeostasis videos:
<http://www.videojug.com/interview/healthy-sleep-for-children#what-is-our-bodys-internal-clock>
6. Biological clock diagram http://commons.wikimedia.org/wiki/File:Biological_clock_human.PNG.
7. Nova sleep movie: <http://www.teachersdomain.org/resource/oer08.sci.life.reg.sleep/>