Biological rhythms, sleep and Dreaming. (PYA4)

What are body rhythms?

- Body rhythms are biological processes that show cyclical variation over time…ranging from hours to years and reflect the influence of the earths rotation upon us… it's living inhabitants, along with plants and animals.

- There are three rhythms that we will focus our attention upon throughout this module.
- *Circadian Infradian, and ultradian biological rhythms.*

Body rhythms cont…

- **Circadian rhythms:**
- (circa = approx & diem = day) go over 24hrs. Humans demonstrate a series of changes including temperature heart respiration and metabolism over this period. We (psychologists) are most interested in the *sleep-wake* cycle.

- **Ultradian rhythms:**
- (Meaning less than one day) Sleep is a good example of an ultradian rhythm, as you sleep you pass through differing stages of sleep (e.g. light and deep sleep lasting about 90 minutes.)

Body rhythms cont…

- **Infradian rhythm:** (meaning more than 1 day). An example of a infradian rhythm would be a woman's menstrual cycle which lasts for 28 days.
- A **circannial** cycle occurs yearly/annually. An example of this would be non human animals hibernation and waking patterns.

Research studies into Circadian rhythms.

- If bodily rhythms show a similar daily pattern for people with different lifestyles it would seem these rhythms are '**part of our nature**' and not our '**upbringing or nurture**'

- So..the next question would be is whether they are natural and triggered internally or whether they rely upon external cues in the environment.

Research studies into Circadian rhythms.

- Siffre (1975) Spent 6 months inside a cave and found that his natural Circadian rhythm was just over 24hrs, but would sometimes change to 48hrs.
- There were no zeitgebers such as natural light or sounds. He had no idea what time it was, although he did have contact with outside world via telephone. He had food and drink and so on. His behaviour such as when he slept/woke and when he ate his meals was monitored. From this study it was concluded our internal clock must have a 25 hr cycle and that our zeitgebers must reset the clock to our usual 24-hr day.

Research studies into Circadian rhythms…

- Another way to test circadian rhythms is to alter our environmental cues.
- Folkard (1985) 12 participants lived in 'temporal isolation' for 3 weeks…isolated from natural light and other time cues. They agreed to go to bed at 11.45pm and get up when it said 7.45am. The clock initially ran to time but gradually quickened until it indicated a passing of 24hrs for 22hrs. All but 1 of the participants kept pace with the clock…thus demonstrating a strong free-running rhythm.

Evaluation of research studies into Circadian rhythms…

- Participants were isolated from exogenous cues (environmental) and we know these have an effect upon our circadian rhythms….but were not isolated from artificial light...it is now known these too can have an effect!!
- Individual differences- Are you a morning or evening person?
- Duffy et al (2000) found early risers prefer 6am-10pm cycles and late starters prefer 10am-1am cycles.

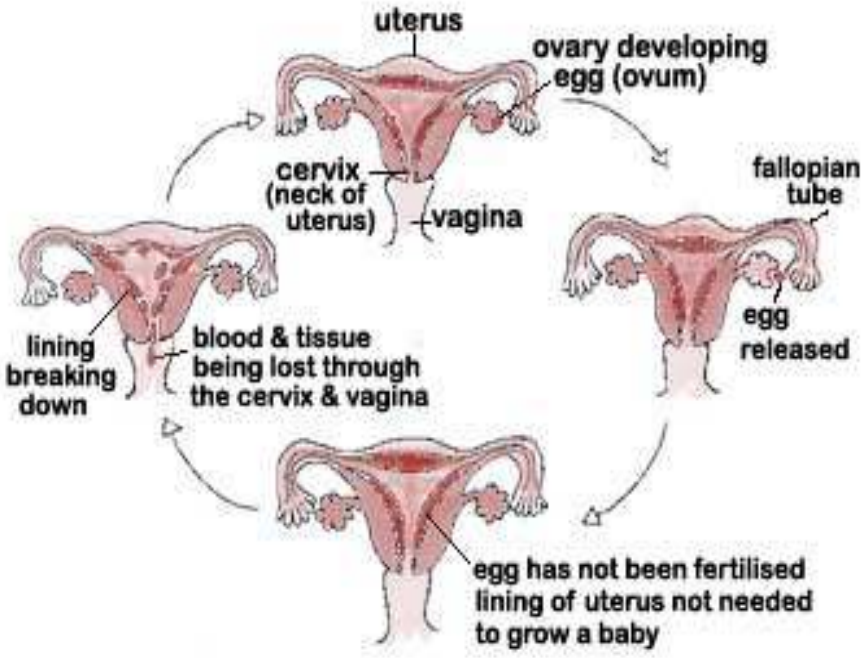
Evaluation of research studies into Circadian rhythms…

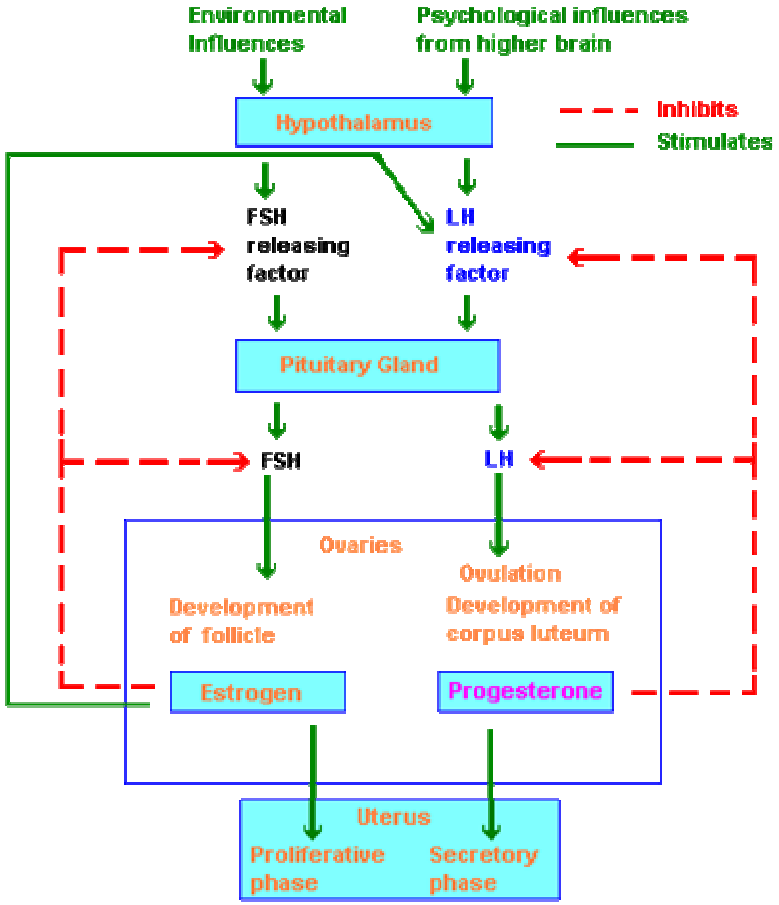
- What everyday application could we gain from studies such as these…(how useful is this stuff really???)

- Deciding the best time to study.
- Taking medication for serious medical conditions. (chronotherapeutics)

Research studies into infradian rhythms.

- Monthly cycles...the function of this cycle is to regulate ovulation.





Research studies into infradian rhythms.

- Seasonal Affective Disorder (SAD). Research has shown that the hormone melatonin is secreted when it is dark...the more darkness...the more melatonin. This leads to severe disruption in mood.

Evaluation of studies into infradian rhythms.

- **Menstrual cycles** can also be disrupted by other factors as well as hormones...research has shown that when a several women live in a house together and they are not taking oral contraceptives they tend to fall in line with each other and menstruate at the same time this be possibly due to pheromones being released chemically and giving a scent.

- **SAD** a greater understanding of this condition has lead to successful therapies such as phototherapy- very strong lights to increase the level of melatonin.

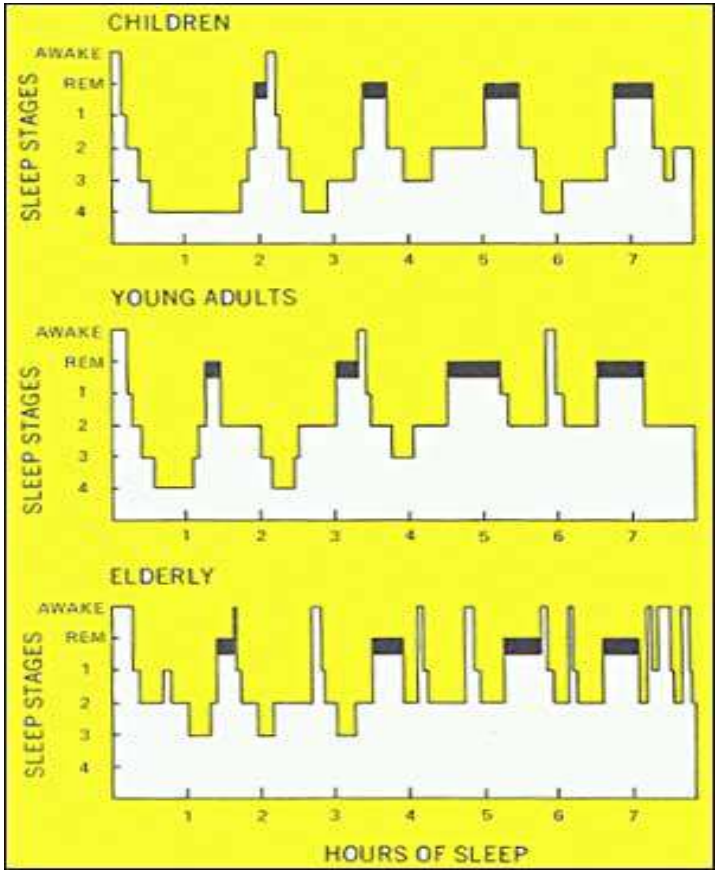
Research studies into Ultradian rhythms.

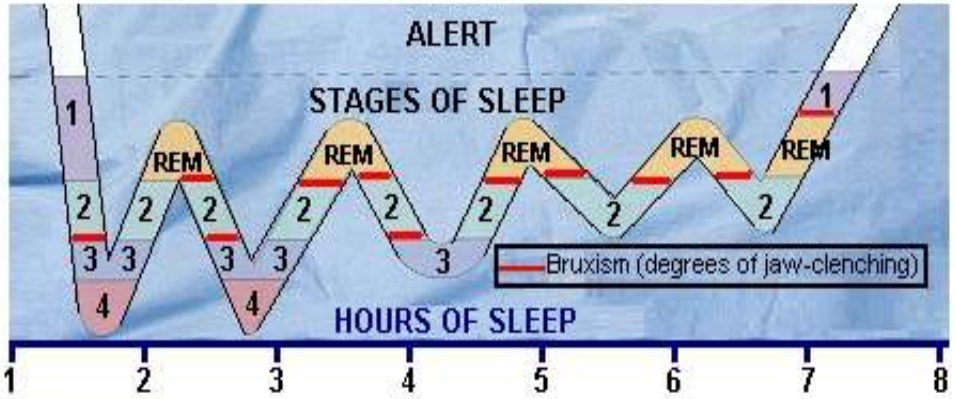
- These are rhythmic cycles with a period of less than one day. Examples include levels of alertness throughout the day and the cycle of brain activity during sleep.

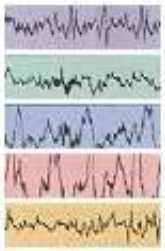
- NREM and REM: There are four stages (1 & 2) which are shallow into deep sleep/slow wave sleep (3 & 4). These cycles continue throughout the night with (SWS) becoming shorter and REM becoming longer as the night progresses. Cycles last for approx 60 mins in early infancy and 90mins in adolescence.

- The use of an **electroencephalogram** (EEG) can show the electrical activity of the brain. There are different patterns of activity at different times during sleep (**Rechtschaffen & Kales, 1968**).

Research studies into Ultradian rhythms….







Stage 1: Alpha waves. Relaxe but wakes immediatly if disturbed

Stage 2: EEG pattern more irregular. More difficult to arrouse

Stage 3: Delta waves appea. Breathing, heart rate, body temp. decrease

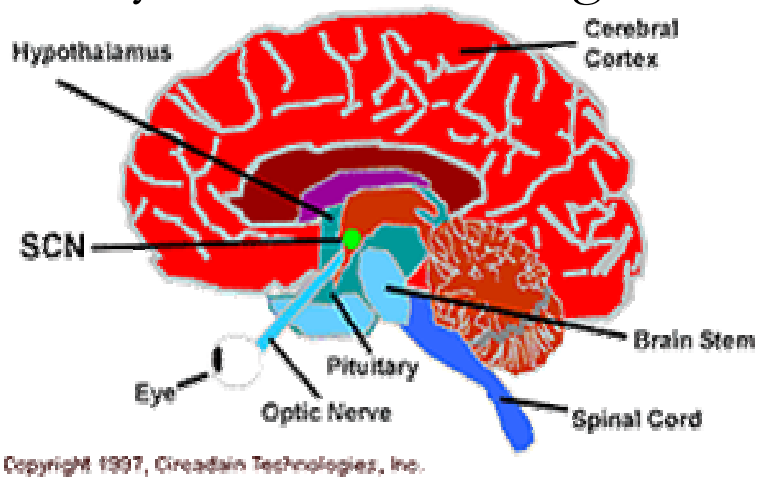
Stage 4: Deep sleep. Delta dominates. Vitals at lowest. Arrousal difficult.

REM : Alphas appear. Vitals increase. Skeletal muscles inhibited. Dreaming.

Bruxism (varying levels of intensity of jaw-clenching) typically occurs at the transition from Stage 2 to Stage 3 sleep, and to a lesser degree when transitioning from Stage 2 into REM and back out of REM. The intensity of the jaw-clenching can be in excess of the patient's voluntary maximum, and the total time of the jaw-clenching activity can exceed 30 mintues. The episodes that precede the Stage 4 restorative sleep may act to "block" the patient from getting to Stage 4. Although the patient sleeps all night, they awake unrefreshed.

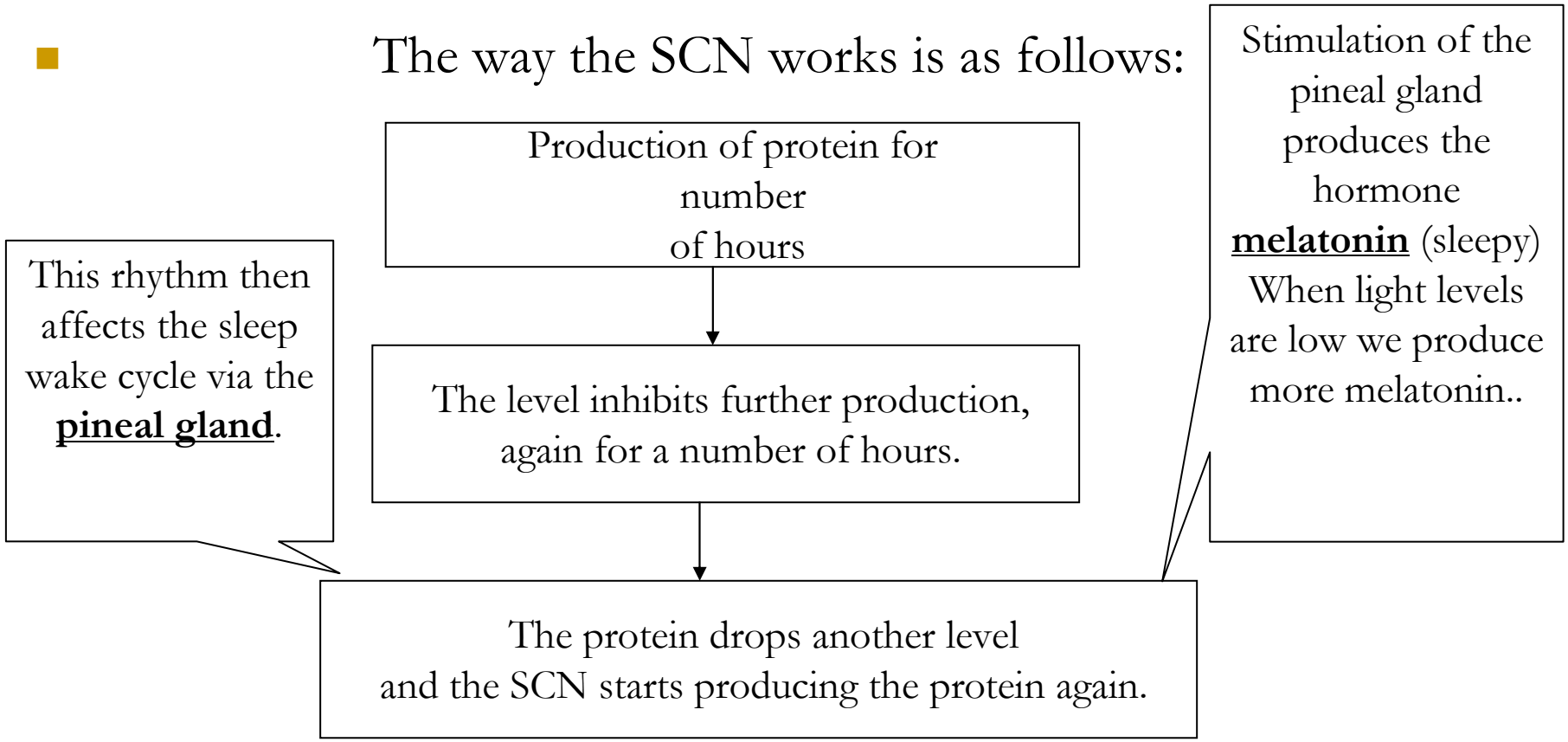
The role of Endogenous pacemakers & Exogenous Zeitgebers.

- The main pacemaker for endogenous (internal) rhythms is the **suprachiasmatic nucleus** (SCN). This is a small group of cells located in the area of the brain called the **hypothalamus.** Its called the SCN because it lies just above the **optic chiasm**, therefore it can receive information directly from the eye and the rhythm can be rest by the amount of light entering the eye.



The role of Endogenous pacemakers & Exogenous Zeitgebers cont….

- The way the SCN works is as follows:



The role of Endogenous pacemakers & Exogenous Zeitgebers cont….

- So what about exogenous (external) pacemakers???

- **Light** is considered to be the most dominant zeitgeber. (see..Miles et al 1977)
- Opposing research also indicates that there are other factors that should be taken into consideration (see..Luce & Segal 1966)

- Overall it appears the sleep-wake cycle is strongly dictated by endogenous pacemakers but we can override these cues.
- **It what circumstances might this happen?**

The role of Endogenous pacemakers & Exogenous Zeitgebers evaluation…

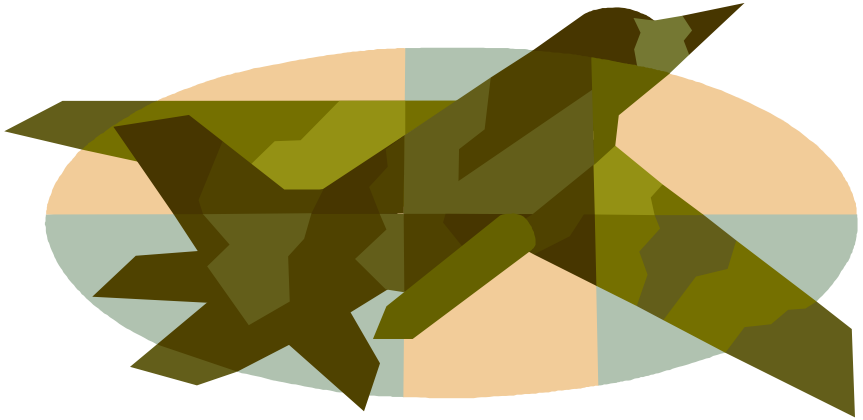
- It is adaptive for endogenous rhythms to be rest by external cues so that animals are in tune with seasonal variations and day/night time. This idea of *adaptive ness* comes from evolutionary perspective that refers to the idea that behaviours which persist are more likely to promote ones survival.

- It could be life threatening if we relied solely upon external cues, therefore we must not forget the significance of internal cues.

The consequences of disrupting Biological rhythms.

- When external cues change we have to re-adjust our internal clock…….

- JET LAG



SHIFT WORK.

Shift Work…..

- Rising early or retiring to bed earlier than normal is an example of phase advance.
- Going to bed late or getting up late is an example of phase delay.
- By delaying/advancing our rhythms we are compromising our ability to cope in the short term.
- On average it takes approx 3 days to adjust to a 12 hour shift in time.

Shift Work…..

- We need doctors, nurses, policeman etc..so how do they cope?
- What happens to their cycle when it is disrupted by shift work?
- Well…we know what sometimes happens when they do work shifts..accidents!
- Lets look more closely at the facts!!

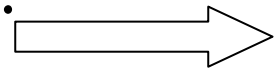
Shift Work…..The Facts!!

- Chernobyl occurred between 1am & 4am.
- Most lorry accidents occur between 4am & 7am.
- In the US $77billion annually as a result of accidents and ongoing medical expenses due to shift work related illnesses.
- Therefore research in this area has important implications.

- **Evidence:** Hawkins and Armstrong-Esther(1978) studied 11 nurses during a 7 night rotation of their duty. Performance was significantly impaired on the first night but improved through the week. (Temps did not adjust until last night!)

Shift Work…How can we lessen the impact/effects of shift work?

- Monk & Folkard (1983) identified two major types of shift work:
- (a) Rapidly rotating shifts: One/two shifts max then they move to different time.
- (b) Slow rotating shifts: Rotate shifts on a weekly/monthly basis.
- Q: Which is the lesser of two evils??
- A: Rapidly rotating….at least they allow the worker to maintain a fairly constant circadian rhythm.



Shift Work…How can we lessen the impact/effects of shift work?

- Rapid rotation means your rhythms are constantly disrupted.
- Research has shown that it is possible to reset the internal clock by using bright lights as a substitute for sunlight.
- *What will this reset?*

- Dawson and Campbell (1991) exposed workers to a 4 hr pulse of very bright light. This appeared to work!

Shift Work…How can we lessen the impact/effects of shift work?

- Phase delay might also be more beneficial..
- Early ⇨ Late
- Late ⇨ Early

It is better to rotate with the clock than against it.

- **Evidence:** Czeisler et al (1982) tested phase delay. Workers in a chemical plant in Utah found phase delay made them feel better. The management also reported increased productivity and fewer errors.

Jet Lag….The Facts.

Jet Lag only occurs when flying from East-West or from West to East.
in other words when we change time zones.

Jet Lag does not occur form North-South and vice versa!!

<u>Example</u>
You fly from Scotland – Boston (USA). You leave at 11am arrive 5pm British time actually it is 12pm in Boston...by 8pm Boston time you'll be tired as it is 1am to you normally!!

Jet Lag….The Facts.

- Klein et al 91972) found that adjustment was faster for westbound flights (going to states) than eastbound ones regardless of whether you were travelling home or going away.
- Eastbound = re-adjustment took 1 day per time zone crossed, therefore how long would it take to recover from a flight to Britain from Boston

?

Jet Lag….

- Its easier to adapt to jet lag when flying in a westerly direction because the day of travel is lengthen, whereas it is shortened when travelling east!
- As our endogenous cycle is about 25 hours we are more able to cope with phase delay than phase advance.
- Huh??? We can stay up when we should be a sleep but we don't like being woken we want to sleep!

Jet Lag….

- **<u>Evidence</u>**

Schwartz et al (1995) found that east coast US baseball teams did better when travelling West (phase delay) than West coast teams who travelled East (phase advance). The time difference was 3 hours. This would give the East coast an advantage!!

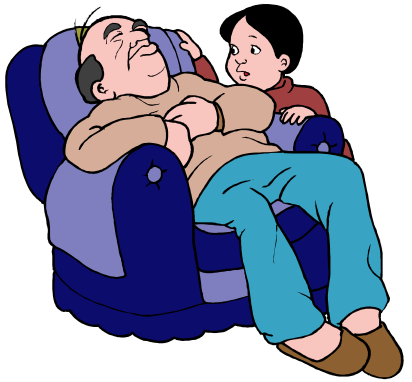
- But what could be a possible problem with this evidence

Jet Lag…How can we lessen the impact/effects of Jet Lag?

- ***Use melatonin to reset the body clock..***
- Should not be used unless intending to stay in new time zone over 3 days.
- Cabin crew tend to do overnight east-west then 24hrs on ground and west-east...taking melatonin in these cases may not be advisable.
- Timing is important too...individuals should be allowed to sleep after the melatonin or else they are prolonging their circadian rhythm.
- There is little scientific evidence on flying performance and melatonin however….cabin crew who have ingested melatonin are not allowed to fly within 36hrs????

- ***Adopt local eating times etc to help reset the biological clock as soon as possible.***

sleep.



- Sleep occupies 1/3 of our time. What we are interested in when we study sleep:
- What function is served by sleep?
- What happens when we are deprived of sleep?
- Why do all animals sleep?
- Why do different animals have different sleep patterns?