Bodily Rhythms

Bodily Rhythms are repeating patterns of variation in bodily activity. Different bodily rhythms have different periodicity i.e. they take place over different timescales.

Psychologists distinguish between three types of bodily rhythm. These are:

- **Ultradian** – have a periodicity of less than 24 hours e.g. the sleep cycle (more later).
- **Circadian -** have a periodicity of about 24 hours e.g. the sleep/wake cycle.
- **Infradian** – have a periodicity of more than 24 hours e.g. the menstrual cycle.

Bodily rhythms are generated by internal biological 'clocks' called **endogenous pacemakers**. They are regulated by external factors called **zeitgebers** ('timegivers').

The Menstrual Cycle

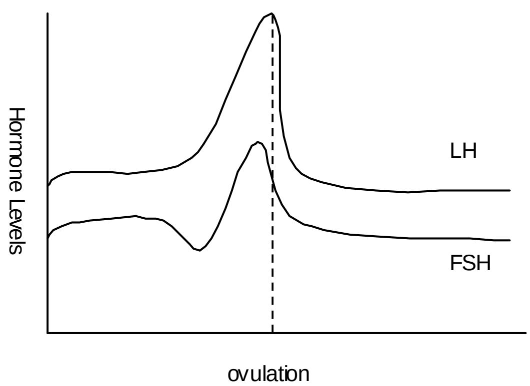
The menstrual cycle in human females is a set of changes in hormonal functioning with a periodicity of about 28 days. It regulates fertility. Women can only conceive a child at a certain point in the menstrual cycle.

Endogenous Pacemakers and the Menstrual Cycle

The menstrual cycle is generated by the hypothalamus, a small structure situated in the middle of the brain. The hypothalamus controls the pituitary glands, which in turn controls a number of other glands situated around the body. These glands produce hormones. Hormones are chemical substances that affect the body's functioning.

Two pituitary hormones are important in determining the menstrual cycle. These are leutinising hormone (LH) and follicle stimulating hormone (FSH). Their fluctuations are shown in fig. 1.

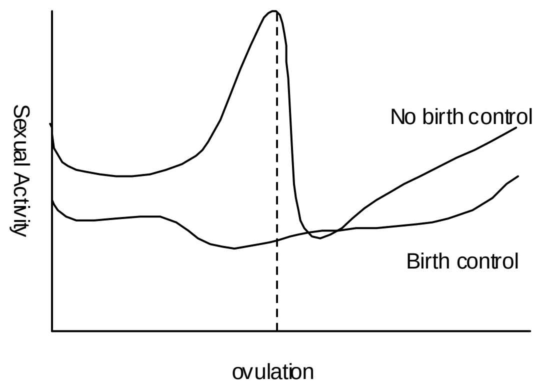
Fig.1 – FSH and LH fluctuations over menstrual cycle



Both FSH and LH levels are constant in the first 10-15 days after menstruation starts. There is then a sudden increase in both, which occurs just before ovulation. After this, they fall rapidly, and are constant until menstruation begins again. The entire cycle lasts about 28 days (Kalat, 1998). The fluctuations in hormone levels are related to fertility. The increase in FSH and LH causes an ovum (egg) to be released, so that fertilisation may occur. There is some evidence that hormone levels may also be related to sexual behaviour in women.

Adams et al (1978)
Aim: to show that female sexual behaviour is linked to the menstrual cycle.
Sample: sexually mature women, some who were taking birth control pills.
Design: pseudo-experiment with independent measures.
Method: women were divided into those who were and those who were not taking birth control pills. They reported their levels of self-initiated sexual activity over a 28-day period.
Result: See fig. 2

Fig 2 - Results of Adams et al (1978)



Amongst women who were not taking the pill, there was an increase in sexual activity around the time of ovulation. Amongst women taking the pill, levels of sexual activity were constant throughout the study.

Conclusion: since the pill works by controlling hormone levels, there was no overall alteration in the behaviour of women taking it. However, the variations in sexual activity amongst women not taking the pill suggests that hormonal fluctuations led to an increase in sexual activity just prior to ovulation. This makes sense, as that is the chance of conception is highest at this point.

Zeitgebers and the Menstrual Cycle

The menstrual cycle was once thought to be regulated wholly internally, by the hypothalamus (the endogenous pacemaker). However, there is now evidence that external factors (zeitgebers) can play a role in when ovulation and menstruation occur. It is thought that women at different stages of the menstrual cycle give off different **pheromones.** Pheromones are chemical substances released by various different animal species that can affect the behaviour of other members of the species. It has been suggested that that human females emit pheromones that can influence the menstrual cycles of the women around them.

McClintock & Stern (1998)
Aim: to show that the menstrual cycle is influenced by pheromonal secretions from other women.
Sample: female university students, not taking birth control pills.
Design: pseudo-experiment with independent measures.
Method: A control group of women wore an alcohol soaked pad in their armpits. The fumes from these were inhaled by another group of women (the experimental group) and their menstrual cycles monitored.
Result: when the experimental group inhaled secretions from women who were about to ovulate, their menstrual cycles became shorter. When they inhaled secretions from women who had just ovulated, their menstrual cycles became longer.
Conclusion: the experimental groups' menstrual cycles were affected by the secretions from the control group. This explains why when a group of women live in close proximity their menstrual cycles tend to synchronise.

Although McClintock's and Stern's findings show that the menstrual cycle is influenced by zeitgebers, and explain to an extent how women's menstrual cycles can come to synchronise, it is still not clear:

(1) Why this should happen. It may well be that there was once an evolutionary advantage to having all the women in a community menstruate at approximately the same time, but there is no strong evidence as yet.
(2) How it happens. Human response to pheromones is not yet well understood, and researchers have not yet discovered the precise substance involved of the mechanism by which it affects the menstrual cycle.

The Sleep-Wake Cycle

Humans have a very regular pattern of sleeping and waking. On average, humans spend about 8 hours in every 24 asleep. For the remainder of the time they are awake. In general, humans (and many other animals) are very regular in their sleeping and waking times, always waking up and going to sleep at about the same time.

Endogenous Pacemakers and the Sleep-Wake Cycle

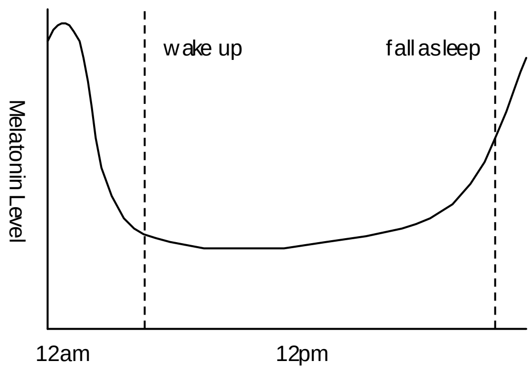
The mammalian sleep-wake cycle is controlled by the **supra-chiasmatic nucleus** (SCN), a small structure situated in the hypothalamus. The SCN is the body's main circadian body clock. It generated a circadian rhythm independently of other brain structures.

Ralph et al (1990)
Aim: to show that the SCN generates the circadian rhythm in mammals.
Sample: hamsters, some with a genetic abnormality affecting their circadian cycle.
Design: laboratory vivisection study.
Method: a group of hamsters was identified with a genetic abnormality that resulted in a 20-hour circadian cycle, rather than a 24-hour one. Their SCNs were removed and placed in the brains of an experimental group of hamsters with a normal 24-hour cycle.
Result: eventually, the experimental group shifted to a 20-hour cycle.
Conclusion: the hamsters' circadian cycle was regulated by the SCN. When normal hamsters were given an abnormal SCN they developed an abnormal circadian cycle.

The SCN regulates the activity of the **pineal gland**. The pineal gland produces a hormone called **melatonin**. It is the level of melatonin in the brain that affects whether or not a person or animal feels sleepy.

In birds and reptiles, the activity of the pineal gland is regulated by light. The pineal gland is light-sensitive and birds and reptiles have thin skulls that daylight can penetrate. When light hits the pineal gland, melatonin production falls, and the animal wakes up. This is why birds tend to wake up as soon as it gets light. Humans and other mammals have thicker skulls, so they need the SCN to regulate the pineal gland. Melatonin production varies over a circadian cycle (see fig. 3). It usually starts to increase between 8pm and 10pm, and most people feel sleepiest about 2 hours later. It begins to fall about 2am and reaches its lowest point around 7am.

Fig. 3 – Melatonin levels over a 24 hour period



Fluctuations in melatonin explain why it is difficult to sleep outside your regular hours. If a person stays awake for much longer than usual, they may not be able to sleep because their melatonin levels are falling. People with damage to their pineal gland may find it difficult to sleep at all (**Haimov & Lavie, 1996**). Taking melatonin as a pill can affect sleeping patterns. If it is taken early in the morning, then the person will go to sleep later than usual. If it is taken in the afternoon, the person will sleep earlier than usual. If it is taken in the evening, it has little effect, because the person's melatonin levels are already high (**Lewy et al, 1996**).

Zeitgebers and the Sleep-Wake Cycle

For many animals, it makes sense for sleep to take place at night, as they are not adapted for activity at night. There needs to be a mechanism to ensure that sleep takes place at night – a zeitgeber. In birds and reptiles (see above) this mechanisms is simple. In humans, it is more complicated.

Kleitman (1967)
Aim: to find out what happens to the sleep-wake cycle when people are isolated from information about the time of day.
Sample: A single human male.
Design: single participant observational study, longitudinal.
Method: A cave explorer, Michel Siffre, spent six months underground. He had no clocks, radios and was cut off from daylight. He was allowed to regulate his own activity as he wished. He was monitored remotely by researchers on the surface.
Result: Siffre's circadian activity cycle lengthened, so he was working to a day of between 25 and 28 hours.
Conclusion: without any external influences, the SCN's endogenous rhythm gets out of synch with the 24 hour day. Therefore, zeitgebers must play a role in regulating the sleep-wake cycle.

In some studies, researchers have tried to alter the length of participants' days artificially. For example, **Kleitman (1963)** put two pps in an environment where they were exposed to a 28 hour day with 9 hours of sleep and 19 hours of activity. One pp managed to adapt quite well, but the other was unable to do so and kept trying to revert to a 24 hour day. **Folkard et al (1985)** did a similar study with 12 pps who attempted to adapt to a 22 hour day. Only one managed it.

Two conclusions can be drawn from these studies:

(1) The body's circadian rhythm can adapt slightly to fluctuations in the external day/night cycle. However, there are limits.
(2) External factors play a role in regulating the sleep-wake cycle.

Daylight

The obvious zeitgeber for mammals (humans included) is daylight. Exposure to daylight seems to have the effect of keeping our endogenous pacemakers from running out of control.

People cut off from daylight can become desynchronised with the day-night cycle. Not only is this shown in **Kleitman (1967)** but in studies of some blind people.

Klein et al (1993) studied a blind man whose circadian rhythm was about 24 ½ hours. He tried to maintain a normal activity cycle, but every so often would get out of synch with the 24 hour day. When this happened, he would sleep very poorly and felt tired during the day. When his own rhythm was nearly in synch with the 24 hour day, he slept well and functioned normally