Human female – menstrual cycle

- unlike that of any mammalian female:
  o there is no sudden change in behaviour / desire at ovulation
  o willing to have sexual intercourse at any time in the cycle

Menstrual cycle – sequence of events occurring in (approximately) 28 days.
(Days give are approximate)

Day 1   menstrual flow / period / menstruation starts:

“break down and release of uterus lining, which together with blood passes out of the body through the vagina.”

- lasts about 4-5 days
- activity low / degenerative phase
- levels of oestrogen and progesterone are low due to the regression of the corpus luteum
- FDH (follicle stimulating hormone) levels begin to rise following inhibition by the release of progesterone

Day 5 – 11

- proliferation phase
- repair of uterus lining
- uterus lining becomes thicker, more vascular (i.e. more blood) and the glands elongate
- these changes occur under the control of oestrogen
- this is released by the ovary under the control of FSH
- FSH release stimulates the development of the “Graafian follicle” in the ovary AND oestrogen from the ovary.
Day 13 - ovulation

- release of an egg (ovum) from the ovary into the oviduct (also known as fallopian tube) from the Graafian follicle.
- stimulated by the peak of oestrogen which initiates a surge of Luteinising hormone (LH - stimulates ovulation) from the pituitary gland

*The menstrual cycle - changes in the blood levels of four sex hormones*

<table>
<thead>
<tr>
<th>Lutenising hormone (LH)</th>
<th>Follicle stimulating hormone (FSH)</th>
<th>Progesterone (P)</th>
<th>Oestrogen (O)</th>
</tr>
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</table>

The individual concentrations are measured in different units, so cannot be compared on this graph. It is the peaks of concentration that matter most.

- for most of the cycle, the cervical muscle is very viscous – containing dense irregular mesh of glycoprotein molecules, which repart an almost impenetrable barrier for spermatozoa
- at the time of ovulation, the muscles become clear – less viscous. It no longer prevents the sperm across the uterus.

Day 15-26

- marked increase in activity of the uterus (endometrium) lining
- under the influence of **progesterone** from the corpus luteum

The corpus luteum is formed from the Graafian follicle in the ovary – after the follicle has released the egg (see previous page). The activity of the corpus luteum is under the influence of LH from the pituitary.

Day 26-28

If no fertilisation

- corpus luteum begins to degenerate
- progesterone secretion decreases
- FSH secretion (previously inhibited by progesterone) begins to rise to initiate a new cycle

If fertilisation has occurred and the zygote has implanted in the uterus lining

- corpus luteum persists and continues to produce progesterone
- this role is later taken over by placental membranes
**Just remember F.O.L.P.**

The hormones are produced in the following order:

1. **FSH:**  
   (a) stimulates development of Graafian follicle  
   (b) stimulates production of oestrogen from the ovary

2. **Oestrogen:**  
   (a) stimulates repair of uterus lining  
   (b) stimulates production of Luteinising hormone in the pituitary

3. **Luteinising hormone:**  
   (a) stimulates ovulation  
   (b) stimulates formation of corpus luteum  
   (c) stimulates production of progesterone

4. **Progesterone:**  
   (a) stimulates maintenance of uterus lining  
   (b) inhibits FSH (via negative feedback) – and so inhibits menstruation.  
   (c) If there is no pregnancy, progesterone stops being produced.

![Diagram](image.png)
**Pregnancy**

- egg fertilised in fallopian tube (oviduct)
- zygote (blastocyst) is implanted into the uterus lining – this is when the woman is said to be pregnant

- the *corpus luteum* persists if implantation occurs. It has various functions:
  - it continues to secrete progesterone
  - it occupies up to 50% of the ovary
  - it maintains the uterus lining and its development
  - it prevents menstruation
  - it inhibits FSH (this is because of the production of progesterone)
  - therefore, it stops the graafian follicle from developing

  - late in pregnancy, a small, but steadily increasing amount of oestrogen is released from the corpus luteum

**After about 3 months**

- placenta develops
- placenta takes over the job of secreting progesterone and oestrogen

**Contraception**

"*deliberate prevention of conception*"

i.e. deliberate prevention of fertilisation of female gamete by male sperm

- use of devices / methods which act against conception

Some methods:

- prevent sperm reaching egg
- interfere with the reproductive cycle preventing implantation or ovulation
- physical devices: chemical manipulation or behavioural techniques may be involved

**Chemical Contraception**

- "*Pill*" – first produced in 1951 – and modified since
- works by "*interfering with the natural menstrual cycle of the female and preventing ovulation*"
- if used effectively: 99% effective
(a) Most Common Pill: **combined contraceptive pill**
- contains low does of both oestrogen and progesterone in **synthetic form**
- the effect: to prevent the release of **LH and FSH** via negative feedback due to the high levels of oestrogen and progesterone
- with oestrogen and progesterone, follicles in the ovary **do not** develop – thus **no ovulation** occurs
- pill taken for 21 days out of 28 of the cycle. The packets produced contain 7 pills, which do not contain any chemicals. These act as the 7 “pill-free” days, which allow a “light menstrual flow” to occur to the low level of progesterone. The menstruation helps as protection against bacteria and infection.
- Pill also exerts effect on other parts of the reproduction tract:
  - mucus in cervix region thickens and this it is more difficult for sperm to penetrate
  - limits the endometrial lining – so that it is more difficult for the zygote to implant (due to the thin lining)

(b) **Progesterone only pill – mini-pill**
- inhibition of ovulation: **does not necessarily** occur
- but uterus lining is thin and so difficult to implant

(c) **New methods**
- implantation of progesterone crystals under skin
- a low constant level of hormone sufficient to reduce fertility
- may last up to 5 years
- advantage over pill: not taken daily

**Treating human infertility** *(i.e. inability to conceive)*
- a growing world problem
- 1 in 8 couples in the UK are affected
- causes vary: either partner may be the cause

**Causes include:**
- long term consequences of STDs
- physiological factors (including hormonal imbalance)
- environmental factors (exposure to pollutants / radiation)
- increasing age of females trying to conceive

**Medical technology** is increasingly used for such couples, but:
- treatment is lengthy
- expensive
- low success rates
- ethical and moral issues
Placenta
- develops in 3rd foetal month
- connects embryo to walls of uterus
- produce villi which grow into uterus wall – providing a large surface area for exchange between maternal and foetal blood (which DO NOT MIX)
- placenta joins to the embryo via umbilical cord
- the umbilical cord contains an artery and a vein
- artery is from the foetus – to the placenta
- the vein is from the placenta – to the foetus
- foetal and maternal blood supplies do not mix
- exchange between blood supplies is carried out by diffusion and active transport (by carrier proteins)

- the diffusion pathway is short – for rapid diffusion
- the blood supply is separated (i.e. do not mix) because:
  - different blood groups may be present
  - the blood pressure is higher in the mother (could damage foetus)
  - in case of infection of mother
- the blood of the mother and the foetus travel in opposite directions

Amnion
- secretes and contains fluid
- to support embryo in uterus
- to protect it from bumps and shocks

Birth
- pregnancy lasts 38 weeks. This is called the gestation period
- in the last 2 weeks, the foetus should turn so the head is at the cervix
- in the last few weeks, the uterus contracts irregularly
- just before labour, amniotic sac bursts and fluid leaks – water breaks
- labour begins – uterus contracts regularly and strongly
- cervix dilates (i.e. widens)
- labour (minutes or hours!) results in baby being forced through birth canal
- the baby takes its first breath (due to temperature drop): lungs inflate
- umbilical cord is cut. It withers away leaving a scar – belly button
- shortly after birth, the placenta detaches and is expelled from the uterus
- this is known as the afterbirth