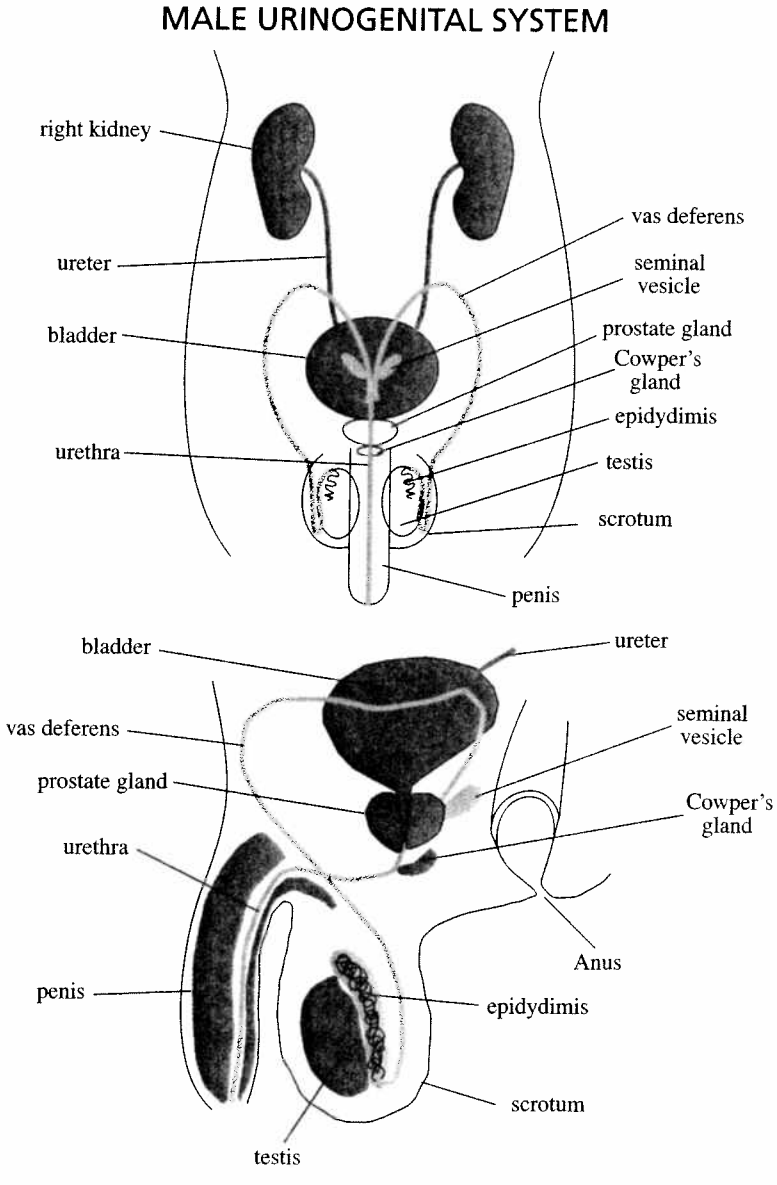
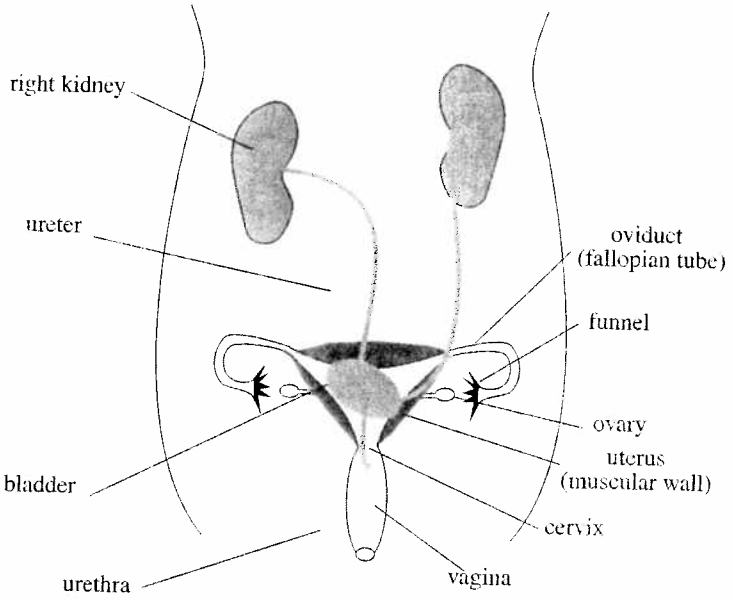
through the kidney are pushed out of the blood vessels into kidney tubules. Only plasma and small dissolved particles can be filtered. Large proteins and cells cannot pass through the filter and remain in the blood. Substances useful to the body, e.g. glucose and amino acids, are then reabsorbed from the filtrate back into the blood. The amount of water and salts reabsorbed is carefully regulated to maintain homeostasis. Unwanted substances such are urea are left in the filtrate which becomes urine and is excreted. Details about the functioning of the kidney can be found in section 12.2

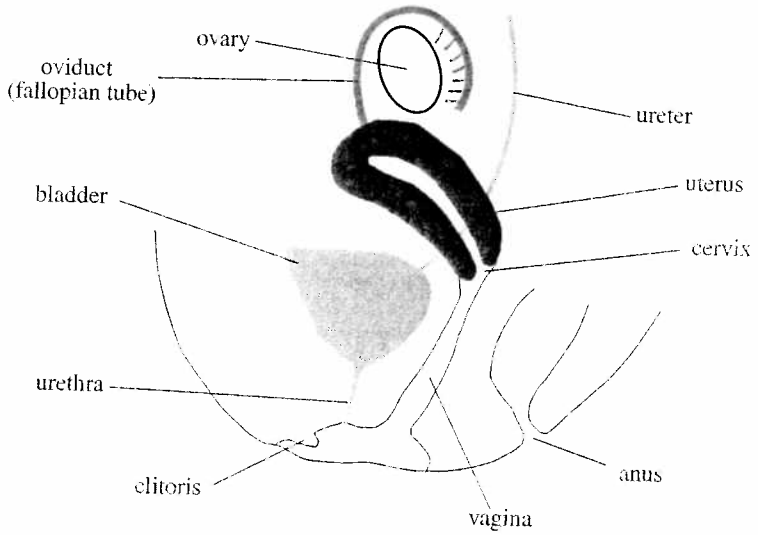
5.7 REPRODUCTION

5.7.1 Draw diagrams of the adult male and female reproductive systems.



FEMALE URINOGENITAL SYSTEM





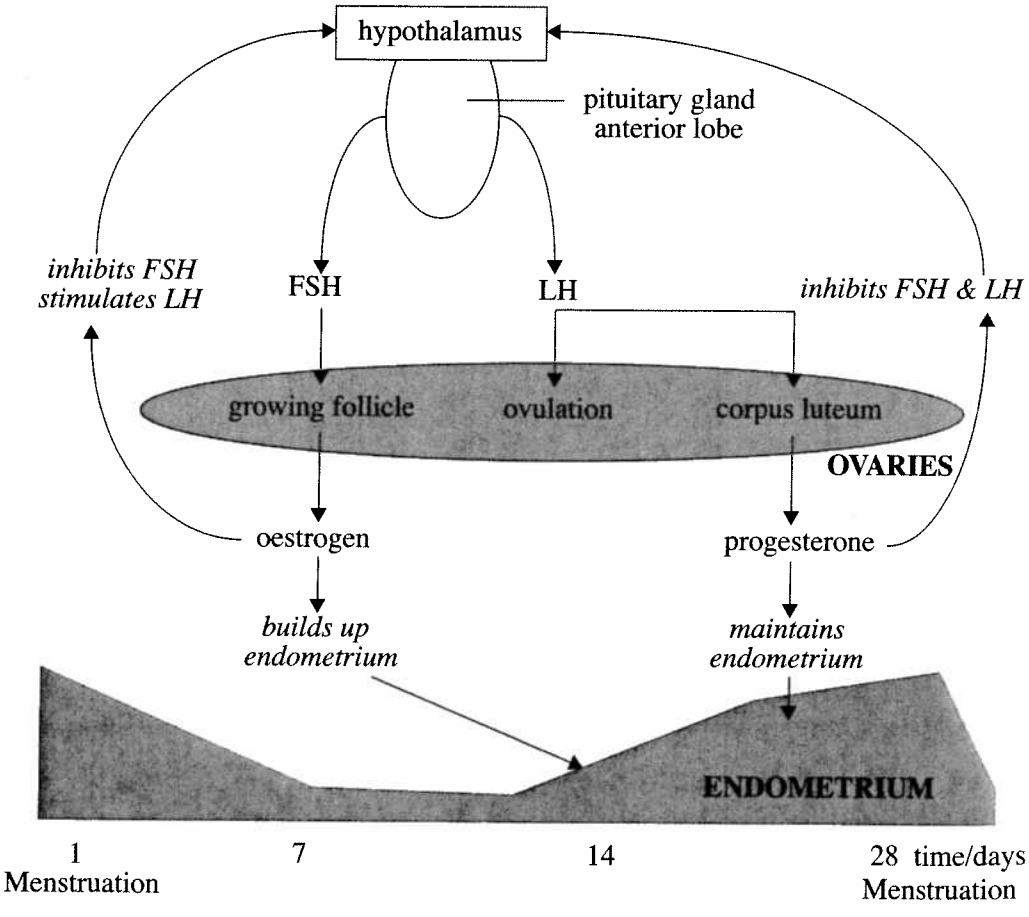
5.7.2 Explain the role of hormones in regulating the changes of puberty (testosterone, estrogen) in boys and girls, and in the menstrual cycle (follicle stimulating hormone (FSH), luteinizing hormone (LH), estrogen and progesterone).

Female

In the female there are 4 hormones involved in the control of the monthly cycle. They are Follicle Stimulating Hormone and Luteinising Hormone, both produced in the anterior

lobe of the pituitary gland, and progesterone and oestrogen, produced in the ovaries. The cycle starts with FSH which stimulates the ripening of a follicle. The growing follicle releases oestrogen. Oestrogen increases the thickness of the endometrium and inhibits the production of FSH but stimulates the production of LH. LH stimulates ovulation and the formation of the **corpus luteum**. The corpus luteum produces progesterone which keeps the endometrium intact and inhibits both FSH and LH. If fertilisation does not occur, the corpus luteus degenerates and the pituitary will start producing FSH again to stimulate another follicle.

EFFECTS OF HORMONES ON THE MENSTRUAL CYCLE



The functions of oestrogen are also to promote the development of female secondary sexual characteristics and the inhibition of milk secretion. High levels of oestrogen can cause nausea. Progesterone will inhibit ovulation and milk secretion.

Male

Although FSH and LH are usually considered to be female hormones they are also present in the male in small concentrations. FSH is present in the male where it promotes spermatogenesis (production of male gametes). LH is also found in males where it is also known as ICSH (interstitial cell stimulating hormone) and it stimulates secretion of testosterone.

Testosterone (and other hormones, together known as androgens) are produced by the Leydig cells which are found near the blood vessels in the interstitial tissue of the testes (in between the seminiferous tubules). Testosterone promotes the male secondary sexual characteristics as well as growth and activity of the male reproductive organs.

5.7.3 List the secondary sexual characteristics in both sexes. © IBO 2001

Secondary sexual characteristics are those which are unique to males or females but not present at birth.
Examples are:
males: facial hair, hair on chest, larger voice box, more muscle.
females: breasts, rounder hips.

5.7.4 State the difference between copulation and fertilization. © IBO 2001

Copulation: the act of coupling of male and female animals in sexual intercourse.
Fertilisation: the fusion of male and female gametes.

5.7.5 Describe early embryo development up to the implantation of the blastocyst. © IBO 2001

After fertilisation, the (haploid) chromosomes of the male and female gametes line up in the equator and prepare for the first mitotic division. This is a division, which is not followed by cell growth and is therefore called a cleavage division. Several of these cleavage divisions occur, which leads to the formation of a solid ball of cells called the morula. In humans, the morula reaches the uterus about 4 days after fertilisation. Then, slightly unequal divisions cause a fluid filled space to form in the middle. The structure is now called blastocyst and will implant in the endometrium. This happens approximately 7 days after fertilisation.

The cells on the outside of the blastocyst are called the **trophoblast**. The trophoblast will embed in the endometrium in the process of implantation. The trophoblast will grow trophoblastic villi into the endometrium and absorb nutrients from it. This is sufficient for about 2 weeks after which the placenta takes over.

5.7.6 State that the fetus is supported and protected by the amniotic sac and amniotic fluid. © IBO 2001

A mass of cells within the trophoblast will eventually form the baby and its surrounding membranes.

A **foetus** is surrounded by amniotic fluid which in turn is surrounded by the **amniotic sac**. The amniotic sac keeps the fluid from leaking out and protects the foetus against infections. The amniotic fluid buffers shocks and protects the baby from mechanical harm. Also, babies drink amniotic fluid and, as a result, urinate in it. It is constantly made and filtered by the mother.

5.7.7 State that materials are exchanged between the maternal and fetal blood in the placenta.

This fast growing foetus needs a good supply of nutrients as well as needing to excrete waste products. Both of these functions are carried out by the **placenta**. The placenta is foetal tissue which invades maternal uterine tissue. The baby's blood runs through blood vessels which go through blood spaces filled with maternal blood. An exchange of substances takes place (diffusion). The foetal blood returns to the foetus enriched with nutrients and oxygen, the maternal blood has taken up the carbon dioxide and other waste products from the foetal metabolism, which it will excrete.

Mother and foetus each have their own blood and circulation. Materials are exchanged but the blood does not mix. Many babies have blood groups different from their mothers.

5.7.8 Outline the process of birth and its hormonal control, including progesterone and oxytocin.

The foetus will (normally approximately 38 weeks after conception) be ready to be born. It will send a signal to the extra-embryonic membranes (like the amniotic sac) which leads to a secretion of **prostaglandins**. These locally produced hormones will initiate contractions of the uterine wall. These contractions push the baby's head against the cervix, making it dilate. Nerve endings in the uterus and cervix will report the contractions to the brain and the posterior lobe of the pituitary gland will release oxytocin. Oxytocin, prostaglandins and a positive feedback system will cause the contractions to become longer and stronger.

When the cervix is fully dilated, the first stage of birth (labour) is over and the second stage (expulsion) begins. While the first stage can take many hours, the second stage usually does not take more than 1 hour. Powerful contractions push the baby out of the uterus.

Now that the uterus is no longer pushing against something, the positive feedback loop is broken and contractions soon reduce. However, a few contractions are needed to expel the placenta from the uterine wall. This is the last stage of birth.

5.7.9 Describe four methods of family planning and contraception.

Contraceptives are aimed at preventing conception. Most methods do this by preventing the meeting of sperm and egg.

Some examples are given below:

Permanent methods:
Sterilisation: Cutting or tying the Fallopian tube (oviduct) which prevents the egg cells from reaching the uterus.

Vasectomy: Cutting or tying the vas deferens which prevents the sperm cells from leaving the body.

Mechanical methods:
Condoms: A thin sheath of rubber rolled over the penis before ejaculation will ensure that sperm cells do not enter the female.

Cap / Diaphragm: A firmer rubber cap placed over the female's cervix before intercourse will prevent sperm cells from entering the uterus.

Chemical methods:
Spermicides: Creams or sponges placed inside the female's vagina which kill sperm cells.

The pill: A tablet containing female hormones. This prevents the release of FSH and thus the formation of the follicle.

Other methods:
IUD: The intra uterine device is placed inside the uterus and prevents implantation of the fertilised egg cell.

Withdrawal: If the man withdraws his penis from the vagina before ejaculation, most of the sperm cells will not enter the female's body.

Rhythm method / Calendar method: Using the calendar or a temperature chart, sexual intercourse is avoided during the fertile period.

The safest are vasectomy/sterilisation and the pill (if used correctly). Diaphragms and condoms are also fairly safe but again need to be used correctly.

Condoms also reduce the chance of Sexually Transmitted Diseases (STD), such as HIV. IUD's do not prevent conception but prevent implantation.

5.7.10 Discuss the ethical issues of family planning and contraception.

Ethical considerations on the use of contraceptives may include:
considerations about overpopulation, considerations about the future of the child(ren), religious considerations. Some religions teach that it is wrong to interfere with natural processes such as reproduction.

5.7.11 Outline the technique of amniocentesis.

Amniocentesis is used to detect genetic disorders in unborn babies. This involves inserting a needle into the uterus via a small incision in the abdominal wall. Amniotic fluid, which contains cells from the embryo, is taken. The cells are cultivated and studied.

More than 400 genetic defects can be diagnosed using these antenatal techniques. Reasons for doing a survey might be the age of the mother or either parent being related to a person with a genetic disorder.

5.7.12 Outline the process of in vitro fertilization (IVF).

IVF is **in vitro fertilisation** ('in vitro' - 'in glass'). In this procedure the egg and sperm cells 'meet' outside the female's body. A successful procedure results in a so called 'test tube baby'. The first test tube baby was Louise Brown, born in 1978.

IVF is used for women who have blocked oviducts (usually due to an earlier infection) or who cannot sustain a pregnancy. Depending on the reasons for the IVF procedure, it may be possible to use the egg cells of the woman who wants to get pregnant. If not, donor egg cells can be used. In either case, the woman generating the egg cells is treated with hormones so that more than one follicle will ripen. A needle is placed in the follicle and the egg cell is sucked out. This is repeated until all egg cells are harvested.

The egg cells are then mixed with sperm cells. This can be supplied by the woman's husband or, if he is not fertile, by a sperm donor. If the quality of the sperm is poor, a sperm cell may be injected into the egg cell. The fertilised egg cells are cultivated and either placed inside the uterus or frozen so that they can be used later. The number of embryos placed in the uterus depends on several factors and ideas about this depend on the country and even the opinion of the doctor involved. It is important to consider that, if all embryos were to implant successfully, that a pregnancy of more than 3 or 4 babies may result in a premature delivery and a reduced chance of survival.