14 Reproduction

Living organisms must **produce offspring** in order for their species to survive.

***Reproduction** is the process by which living organisms generate new individuals of the same kind as themselves.*

There are two types of reproduction:

- **asexual reproduction**
- **sexual reproduction.**

Asexual and sexual reproduction compared

Asexual reproduction

Asexual reproduction involves only **one** parent and offspring are produced by **mitosis** (see page 145). All offspring produced asexually from one parent are **genetically identical** and are collectively called a **clone**. Asexual reproduction is **conservative** because it conserves the characteristics of the parent. Certain plants (see page 147) as well as fungi and unicellular organisms, e.g. amoeba and bacteria, reproduce asexually.

Sexual reproduction

Sexual reproduction involves **two** parents. **Gametes**, or sex cells, are produced in reproductive organs by **meiosis** (see page 147). A male and a female gamete fuse during **fertilisation** to form a single cell called a **zygote**. The zygote divides by **mitosis** to form an **embryo** and ultimately an **adult**. Offspring produced sexually receive genes from both parents, therefore they possess characteristics of both parents, i.e. they show **variation**.

Table 14.1 *Asexual and sexual reproduction compared*

Asexual reproduction	Sexual reproduction
Produces **no variation** among offspring; all are identical. Consequently: • If the parent is well adapted to its environment, **all** offspring will be well adapted and the chances of them **all** surviving will be high. **(A)** • If environmental conditions change adversely, **all** offspring will be adversely affected, reducing the chances of survival of **all** offspring. **(D)** • It does not enable species to change and adapt to changing environmental conditions. **(D)**	Produces **variation** among offspring; no two organisms are identical. Consequently: • Some offspring may be better adapted to their environment than their parents, others may not be as well adapted, consequently they do **not all** have an equal chance of survival. **(D)** • If environmental conditions change, **some** offspring may be better adapted to the new conditions, increasing the chances of survival of **some** offspring. **(A)** • It enables species to **change** and adapt to changing environmental conditions. **(A)**
The process is **rapid**. It does not involve finding a mate, producing gametes, fertilisation and development of an embryo. This results in a rapid increase in numbers of organisms in populations. **(A)**	The process is **slow**. A mate has to be found in animals, gametes have to be produced, fertilisation has to occur and the embryo has to develop. This results in a slow increase in numbers of organisms in populations. **(D)**
Offspring usually remain **close** to the parent, which increases the chances of overcrowding and competition. **(D)**	Offspring are usually **dispersed** over a wide area, which reduces the chances of overcrowding and competition. **(A)**

(A) = advantage **(D)** = disadvantage

Many plants use **both** methods of reproduction, thus combining the **advantages** of both, e.g. many species of grass reproduce asexually by producing runners and sexually by producing flowers and seeds.

- **Asexual reproduction** does not allow species to change and adapt to changing conditions. It is beneficial in a stable, unchanging environment, or in an under-crowded environment.
- **Sexual reproduction** enables species to change and adapt to changing conditions. It is beneficial in an unstable, changing environment, or in an overcrowded environment.

Sexual reproduction in humans

The female reproductive system

The female gametes are called **ova** and they are produced in two **ovaries** which form part of the female reproductive system.

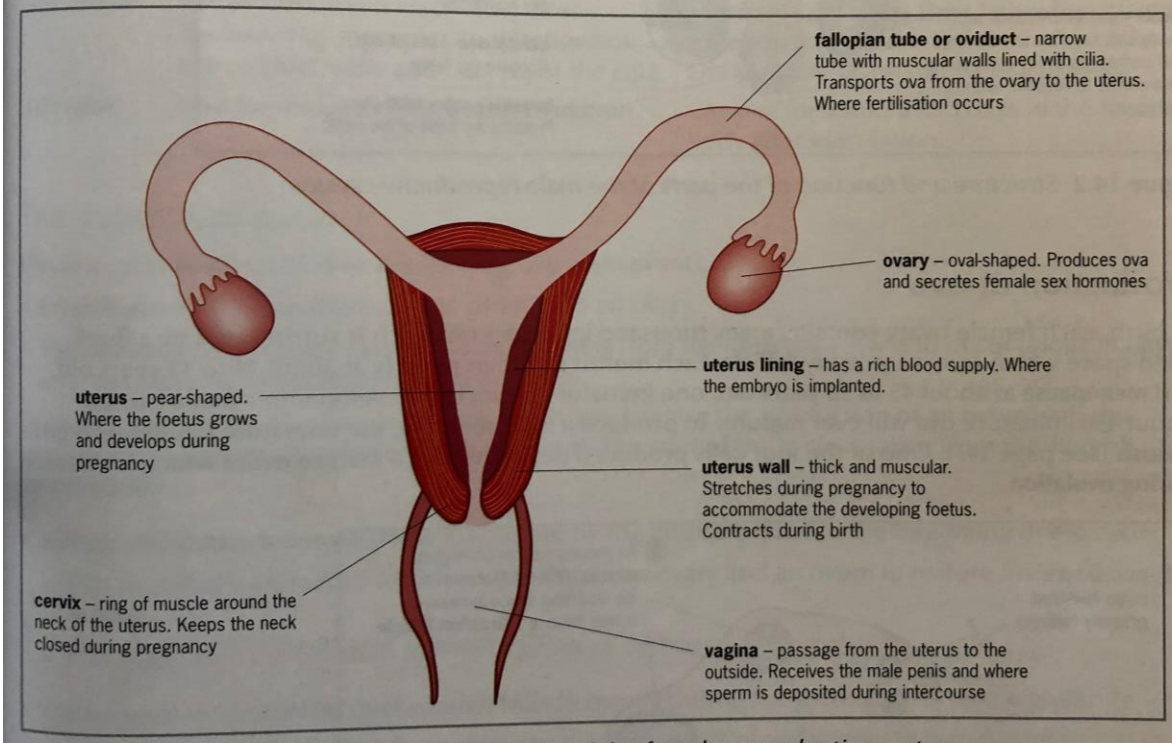


Figure 14.1 *Structure and function of the parts of the female reproductive system*

The male reproductive system

The male gametes are called **sperm** or **spermatozoa** and they are produced in the **testes** which form part of the male reproductive system. Unlike the ovaries which are inside the female body, the testes are located outside the body in a sac called the **scrotum**. This keeps the sperm at a slightly lower temperature than body temperature which is essential for their proper development.

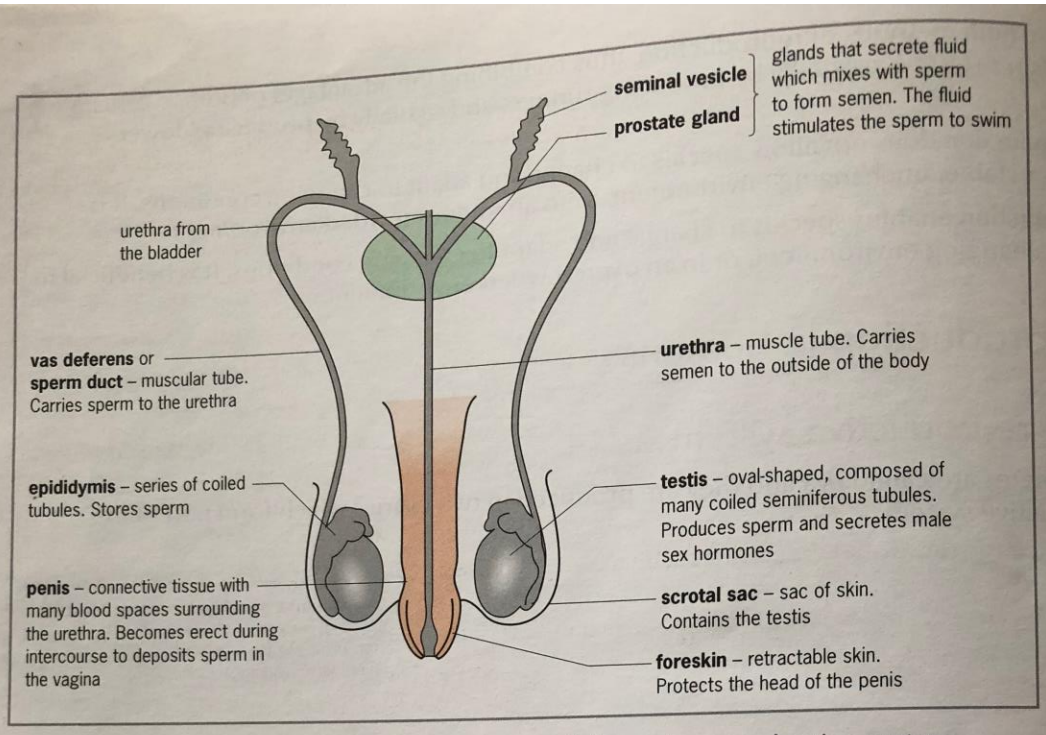


Figure 14.2 *Structure and function of the parts of the male reproductive system*

Production of ova

At birth, each female ovary contains many thousand **immature ova**. Each is surrounded by a fluid-filled space which forms a **primary follicle**. Each month between **puberty** at about 11 to 13 years old, and **menopause** at about 45 to 50 years old, one immature ovum will develop into a **mature ovum**. About 450 immature ova will ever mature. To produce a mature ovum, the immature ovum undergoes **meiosis** (see page 147). One of the four cells produced develops into a mature ovum which is released during **ovulation**.

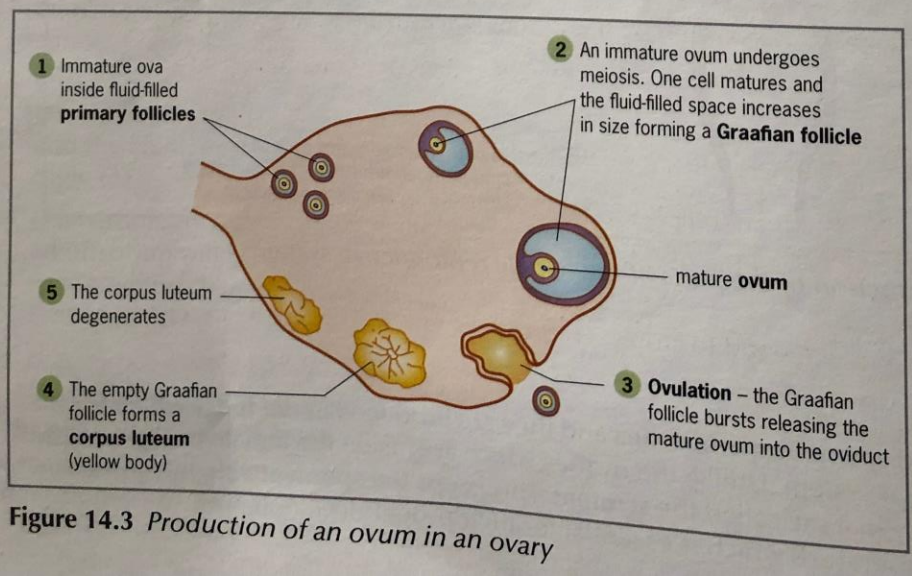
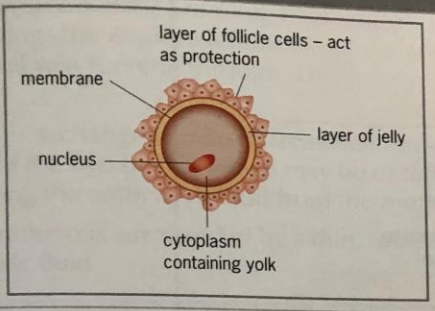
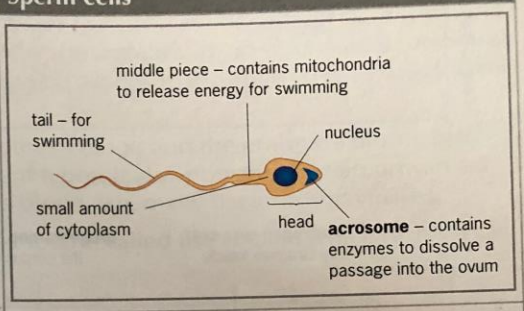


Figure 14.3 *Production of an ovum in an ovary*

Table 14.2 *Ova and sperm cells compared*

	Ova	Sperm cells
Structure		
Production	One is produced each month from puberty to menopause.	Thousands are produced continuously from puberty.
Movement	Are moved down an oviduct after ovulation by muscular contractions of the oviduct walls and beating of the cilia.	Swim actively using their tails when mixed with secretions from the seminal vesicles and prostate gland during ejaculation.
Life span	Live for about 24 hours after ovulation.	Can live for about 2 to 3 days in the female body after ejaculation.

The menstrual cycle

This is a cycle of about 28 days comprising two main events:

- **Ovulation** which is the release of an **ovum** from an ovary.
- **Menstruation** which is the loss of the **uterus lining** from the body. This starts to occur about 14 days after ovulation if fertilisation has not occurred.

The cycle is controlled by **four hormones** which synchronise the production of an ovum with the uterus lining being ready to receive it if fertilised. The start of the cycle is taken from the start of menstruation.

- **Follicle stimulating hormone (FSH)** is secreted by the pituitary gland at the beginning of the cycle.
  - FSH stimulates a Graafian follicle to develop in an ovary and an ovum to mature inside the follicle.
  - FSH stimulates the Graafian follicle to produce **oestrogen**.
- **Oestrogen** is produced by the Graafian follicle mainly during the second week of the cycle.
  - Oestrogen stimulates the uterus lining to thicken and its blood supply to increase after menstruation.
  - Oestrogen causes the pituitary gland to stop secreting FSH and to secrete **luteinising hormone (LH)**.
- **Luteinising hormone (LH)** is secreted by the pituitary gland in the middle of the cycle.
  - A sudden rise in LH causes ovulation to take place.
  - LH stimulates the corpus luteum to develop in the ovary and secrete **progesterone**.
- **Progesterone** is produced by the corpus luteum during the third week of the cycle.
  - Progesterone causes the uterus lining to increase slightly in thickness and remain thick.
  - If fertilisation does not occur, the corpus luteum degenerates during the fourth week and reduces secretion of progesterone. The decrease in progesterone causes the uterus lining to begin to break down, and the pituitary gland to secrete **FSH** at the end of the fourth week.

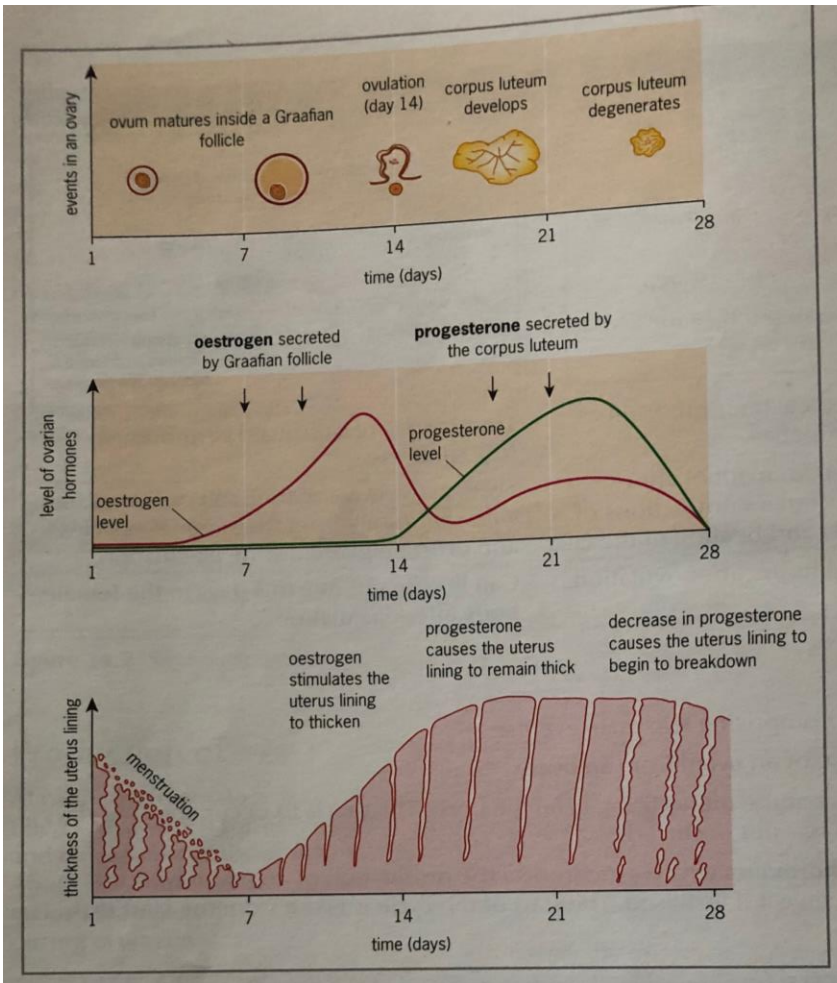


Figure 14.4 *A summary of the events occurring during the menstrual cycle*

Bringing sperm and ova together

When a male becomes sexually excited, blood spaces in the penis fill with blood. The penis becomes **erect** and is placed into the female vagina. **Semen**, composed of sperm and secretions from the seminal vesicles and prostate gland, is **ejaculated** into the top of the vagina by muscular contractions of the tubules of the epididymis and sperm ducts. The **sperm** swim through the cervix and uterus and into the oviducts.

From fertilisation to birth

Fertilisation

If an **ovum** is present in one of the oviducts, one **sperm** enters leaving its tail outside. A **fertilisation membrane** immediately develops around the ovum to prevent other sperm from entering and the nuclei of the ovum and sperm fuse to form a **zygote**.

Implantation

The zygote divides repeatedly by **mitosis** using **yolk** stored in the original ovum as a source of nourishment. This forms a ball of cells called the **embryo** which moves down the oviduct and sinks into the uterus lining, a process called **implantation**. Food and oxygen diffuse from the mother's blood into the embryo and carbon dioxide and waste diffuse back into the mother's blood.

The cells of the embryo continue to divide and some of the cells develop into the **placenta**. The placenta is a disc of tissue with capillaries running throughout and finger-like projections called **villi** that project into the uterus lining. The embryo is joined to the placenta by the **umbilical cord** which has an **umbilical artery** and **umbilical vein** running through. These connect the capillaries in the embryo with those in the placenta.

The **placenta** allows exchange of materials between the mother's blood and the embryo's blood, but prevents mixing of the two bloods which may be of different types. It also prevents certain unwanted substances entering the embryo's blood from the mother's blood, e.g. many bacteria and viruses.

The developing embryo is surrounded by a thin, tough membrane called the **amnion** which forms a sac containing **amniotic fluid**.

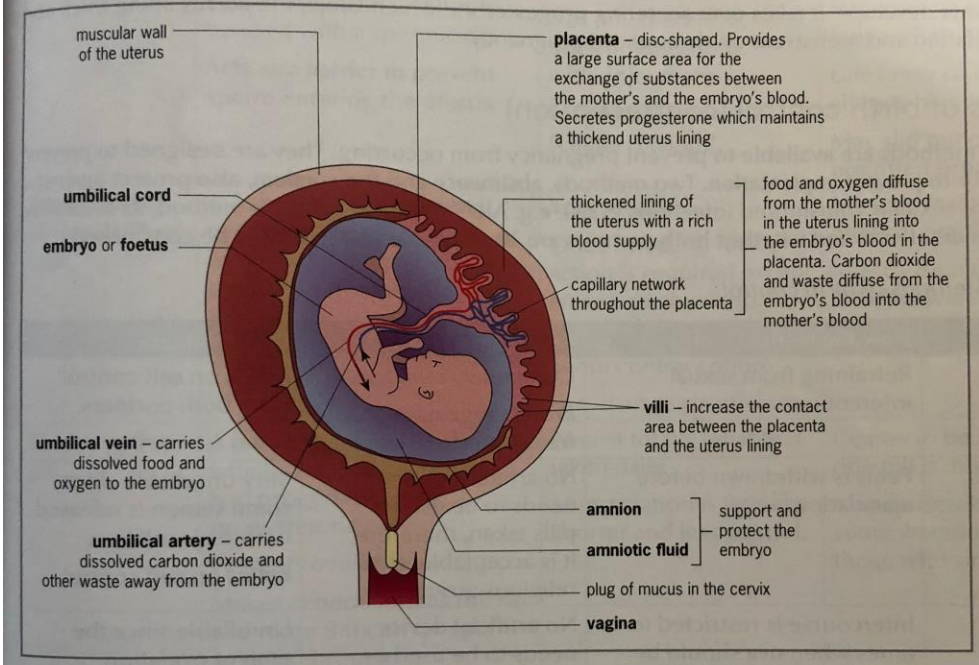


Figure 14.5 *The developing human embryo/foetus in the uterus*

Table 14.3 *The development of a human embryo/foetus*

Time after fertilisation	Characteristics
7 to 10 days	A hollow ball of cells that is implanted in the uterus lining.
4 weeks	The brain, eyes and ears are developing along with the nervous, digestive and respiratory systems. Limb buds are forming and the heart is beginning to beat.
8 weeks	The embryo has a distinctly human appearance. All the vital organs have been formed and limbs with fingers and toes are developed.
10 weeks	The embryo is now known as a **foetus**. External genitals are beginning to appear, fingernails and toenails form and the kidneys start to function.
11 to 38 weeks	The foetus continues to grow and the organs continue to develop and mature.
38 weeks	Birth occurs.

N.B. The **gestation period (pregnancy)** is considered to last for 40 weeks or 280 days since it is calculated from the first day of the last menstrual cycle and not from the time of fertilisation.

The foetus turns so it lies head down. Secretion of progesterone by the placenta is reduced and this stimulates the **pituitary gland** to secrete the hormone **oxytocin**. Oxytocin stimulates muscles in the uterus wall to start contracting, i.e. **labour** begins. The amnion bursts and the contractions cause the cervix to dilate. When fully dilated the baby is pushed, head first, through the cervix and vagina. The umbilical cord is cut and the placenta is expelled as the **afterbirth** by further contractions of the uterus wall.

The effect of pregnancy on the menstrual cycle

If fertilisation takes place, the **corpus luteum** remains in the ovary and it secretes increasing amounts of **progesterone**. This causes the uterus lining to increase in thickness and it prevents menstruation. As the **placenta** develops, it takes over secreting progesterone which keeps the uterus lining thick and inhibits ovulation and menstruation throughout pregnancy.

Methods of birth control (contraception)

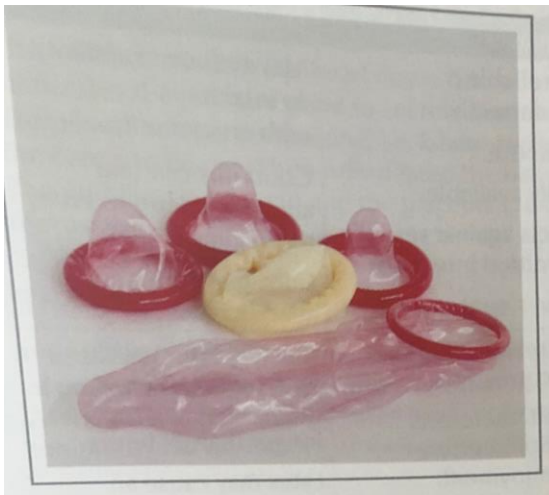
A variety of methods are available to prevent pregnancy from occurring. They are designed to **prevent fertilisation** or to **prevent implantation**. Two methods, **abstinence** and the **condom**, also protect against the spread of sexually transmitted infections (STIs), e.g. AIDS. When choosing a method, its reliability, availability, side effects and whether both partners are comfortable using it, must be considered.

Table 14.4 *Methods of birth control*

Method	How the method works	Advantages	Disadvantages
Abstinence	Refraining from sexual intercourse.	Completely effective. Protects against sexually transmitted infections.	Relies on self control from both partners.
Withdrawal	Penis is withdrawn before ejaculation.	No artificial device needs to be used or pills taken, therefore, it is acceptable to all religious groups.	Very unreliable since some semen is released before ejaculation. Relies on self control.
Rhythm method	Intercourse is restricted to times when ova should be absent from the oviducts.	No artificial device needs to be used or pills taken, therefore, it is acceptable to all religious groups.	Unreliable since the time of ovulation can vary. Restricts the time when intercourse can occur. Unsuitable for women with an irregular menstrual cycle.
Spermicides	Creams, jellies or foams inserted into the vagina before intercourse. Kill sperm.	Easy to use. Readily available.	Not reliable if used alone, should be used with a condom or diaphragm. May cause irritation or an allergic reaction.

Method	How the method works	Advantages	Disadvantages
Condom	A latex rubber or polyurethane sheath placed over the erect penis or into the female vagina before intercourse. Acts as a **barrier** to prevent sperm entering the female body.	Very reliable if used correctly. Easy to use. Readily available. Protects against sexually transmitted infections.	May reduce sensitivity so interferes with enjoyment. Condoms can tear allowing sperm to enter the vagina. Latex may cause an allergic reaction.
Diaphragm	A dome-shaped latex rubber disc inserted over the cervix before intercourse. Should be used with a spermicide. Acts as a **barrier** to prevent sperm entering the uterus.	Fairly reliable if used correctly. Not felt, therefore, does not interfere with enjoyment. Easy to use once the female is taught.	Must be left in place for 6 hours after intercourse, but no longer than 24 hours. Latex may cause an allergic reaction. May slip out of place if not fitted properly.
Intra-uterine device (IUD or coil)	A T-shaped plastic device, usually containing copper or progesterone, inserted into the uterus by a doctor. Prevents sperm reaching the ova or prevents implantation.	Very reliable. Once fitted, no further action is required except an annual check-up. No need to think further about contraception. Few, if any, side effects.	Must be inserted by a medical practitioner. May cause menstruation to be heavier, longer or more painful.
Contraceptive pill	A **hormone** pill, taken daily, which contains oestrogen and progesterone, or progesterone only. Prevents ovulation. Makes cervical mucus thicker and more difficult for sperm to swim through.	Almost totally reliable if taken daily. Menstruation is lighter, shorter and less painful.	Ceases to be effective if one pill is missed. May cause side effects in some women, especially those who smoke.
Surgical sterilisation	The sperm ducts or oviducts are **surgically** cut and tied off. Prevents sperm leaving the male body or ova passing down the oviducts.	Totally reliable. No need to think further about contraception. No artificial device needs to be used or pills taken.	Usually irreversible.

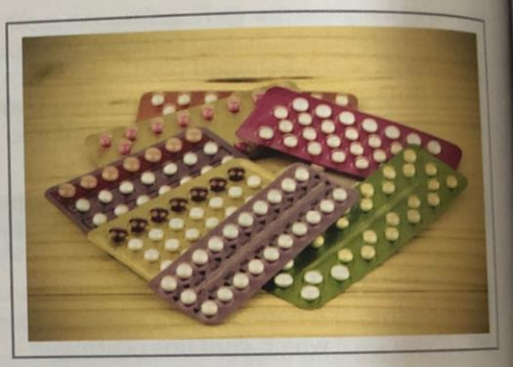
N.B. One **disadvantage** of all methods except abstinence and condoms is that they do not protect against sexually transmitted infections.



Condoms

Diaphragm

Intra-uterine device (IUD)



Contraceptive pills

The importance of birth control

Birth control is used to **prevent unintended pregnancies**, therefore, it allows couples to plan when they have children and how many. Access to birth control:

- Decreases health risks to women and maternal deaths caused by unintended pregnancies and unsafe abortions.
- Decreases infant deaths and improves the health and overall care of infants by enabling women to increase the spacing between births.
- Enables family sizes to be limited so each child is provided for emotionally, physically and educationally by having frequent contact with parents.
- Enables women to participate fully in society and advance in the workplace by allowing them to plan for their future and invest in their careers.

From a **global** perspective, the human population is growing rapidly; it is estimated that it will increase from 7.3 billion in 2015 to over 9 billion in 2050. Predictions are that this will result in shortages of food, water, natural resources and land for housing, crops and livestock; will increase pollution, the destruction of the environment, unemployment and the spread of disease; and will decrease living standards. Birth control can **reduce population growth** which should help maintain a healthy, productive environment without shortages, and increase living standards.

Sexually transmitted infections (STIs)

Infections passed on during **sexual intercourse** are called sexually transmitted infections or STIs. These include HIV/AIDS, gonorrhoea, syphilis and genital herpes.

Table 14.5 *Two sexually transmitted infections*

Infection	Causative agent	Methods of transmission	Methods of treatment	Methods of prevention and control
AIDS – acquired immune deficiency syndrome	HIV – human immunodeficiency virus.	• Unprotected sexual intercourse with an infected person. • Using infected hypodermic needles or cutting instruments, e.g. razors. • Transfusions of infected blood products. • Infected mother to baby during pregnancy and breast feeding.	• Antiretroviral drugs to interrupt the duplication of HIV. This keeps the amount of HIV in the body at a low level which delays the onset of opportunistic infections. • Drugs to enhance the immune system. • Drugs to treat opportunistic infections. • No cure exists.	• Treat all cases, especially pregnant women. • Set up education programmes. • Abstain from sexual intercourse or keep to one, uninfected sexual partner. • Use condoms during sexual intercourse. • Trace and treat all sexual contacts of infected persons. • Don't use intravenous drugs or share cutting instruments. • Use sterile needles for all injections. • Test all human products to be given intravenously for HIV. • No vaccine exists.
Gonorrhoea	Bacterium – *Neisseria gonorrhoeae*.	• Unprotected sexual intercourse with an infected person. • Mother to the eyes of her baby during childbirth which leads to blindness if not treated.	• Antibiotics that are specialised to destroy *Neisseria gonorrhoeae*.	• Treat all cases, especially pregnant women. • Set up education programmes. • Abstain from sexual intercourse or keep to one, uninfected sexual partner. • Use condoms during sexual intercourse. • Trace and treat all sexual contacts of infected persons. • No vaccine exists.

Implications of HIV/AIDS

A combination of factors makes the spread of HIV/AIDS very difficult to control:

- There is currently **no vaccine** or **cure** for HIV/AIDS.
- The **time interval** between the virus entering the body and symptoms developing may be several years. During this time the infected person can pass on the virus without knowing it.
- **Highly active antiretroviral therapy (HAART)** where a patient takes a combination of three or more antiretroviral drugs is relatively expensive and must be taken for a patient's lifetime making the cost ongoing.
- It can be difficult to persuade people to change their **sexual behaviour**.

The continual spread of HIV/AIDS has a variety of **consequences** including:

- Shortened life expectancies.
- Job loss resulting in loss of earnings.
- Increased expenditure for medical care and an increased strain on health services.
- Discrimination.
- Neglect by relatives and friends.
- Parentless children.
- Decreased standards of living.

With education, some of these are preventable.

Revision questions

1. **a** Give THREE differences between asexual and sexual reproduction.
   b Give ONE advantage and ONE disadvantage of EACH type of reproduction in **a** above.
2. By means of a labelled and annotated diagram, describe the functions of the different parts of the female reproductive system.
3. **a** Describe the events taking place in the ovaries and uterus during one complete menstrual cycle.
   b Name FOUR hormones involved in controlling the menstrual cycle.
4. What effect does pregnancy have on the menstrual cycle?
5. Outline the mechanism by which sperm and ova come together to form a zygote in humans.
6. What part does EACH of the following play in the development of a human embryo?
   a the amniotic fluid **b** the placenta **c** the umbilical cord.
7. Construct a table that explains how EACH of the following methods of birth control prevents pregnancy, and gives ONE advantage and ONE disadvantage of EACH method: the contraceptive pill, surgical sterilisation, the rhythm method and the condom.
8. Identify THREE ways AIDS is transmitted and THREE ways of controlling its spread.
9. Discuss some of the social implications of the continual spread of AIDS and other sexually transmitted infections.

Sexual reproduction in flowering plants

Flowering plants produce **flowers** for **sexual reproduction**. A flower consists of an expanded stem tip, the **receptacle**, which usually bears four whorls (rings) of modified leaves, **sepals**, **petals**, **stamens**, and one or more **carpels** in the centre.

Most flowers contain both female and male reproductive parts. The female parts are the **carpels**; these produce one or more **ovules** which contain the female gametes. The male parts are the **stamens**; these produce the **pollen grains** which contain the male gametes.

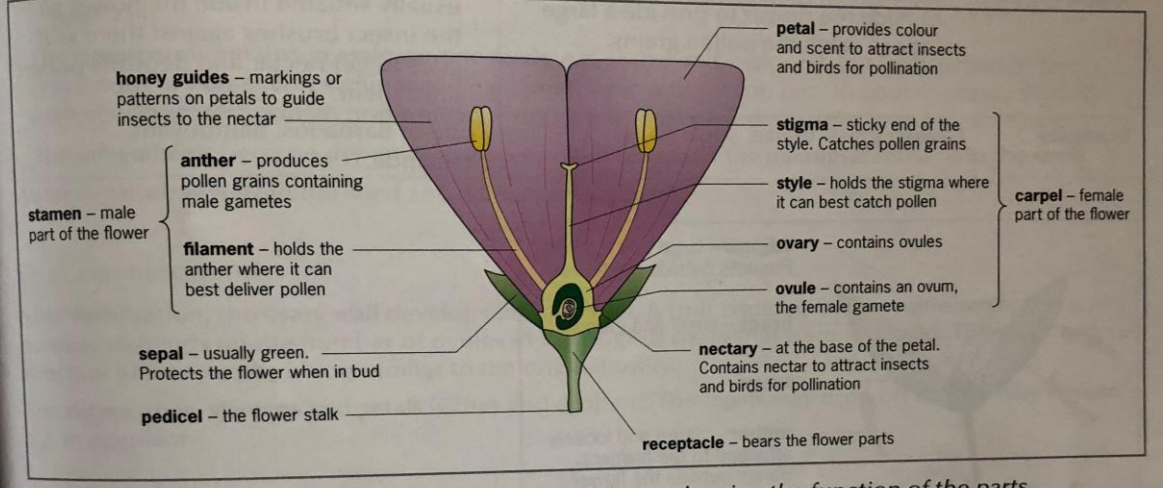


Figure 14.6 *A longitudinal section of a generalised flower showing the function of the parts*

Pollination

***Pollination** is the transfer of pollen grains from the anthers to the stigmas of flowers.*

Pollination leads to **fertilisation** and there are two types:

- **Self pollination** occurs when a pollen grain is transferred from an anther to a stigma of the **same flower** or to a stigma of another flower on the **same plant**.
- **Cross pollination** occurs when a pollen grain is transferred from an anther of a flower on one plant to a stigma of a flower on a **different plant** of the **same species**.

Agents of pollination carry the pollen grains between flowers. They may be the **wind**, **insects** and some **birds**, e.g. humming birds. Flowers are usually **adapted** to be pollinated by wind or by insects.

Table 14.6 *Comparing flowers adapted for wind pollination and insect pollination*

	Wind pollinated	Insect pollinated
Flower	• Usually small and inconspicuous.	• Usually large and conspicuous.
Petals	• Often absent. If present they are small, green or dull coloured and have no scent, nectar or honey guides. There are no pollinating agents to attract.	• Usually relatively large, brightly coloured and scented, and have nectaries and honey guides to attract insects.
Pollen grains	• Small, smooth and light so they are easily carried by the wind. • Large quantities are produced as many are lost.	• Relatively large, sticky or spiky to stick onto the body of insects. • Smaller quantities are produced as fewer are lost.

	Wind pollinated	Insect pollinated
Stamens	• Anthers are loosely attached to long, thin filaments and they hang outside the flower so the pollen can be easily blown off them by the wind. • Anthers are large to produce a lot of pollen grains.	• Anthers are firmly attached to short, stiff filaments, and are usually inside the flower so the insect brushes against them as it goes to get nectar and picks up pollen grains without damaging the anthers.
Stigmas	• Long, branched and feathery and hang outside the flower to provide a large area to catch the pollen grains.	• Flat or lobed and sticky, and are usually situated inside the flower so the insect brushes against them as it goes to get nectar and deposits pollen onto them.
Examples	Guinea grass, maize, sugar cane.	Pride of Barbados, flamboyant, allamanda.

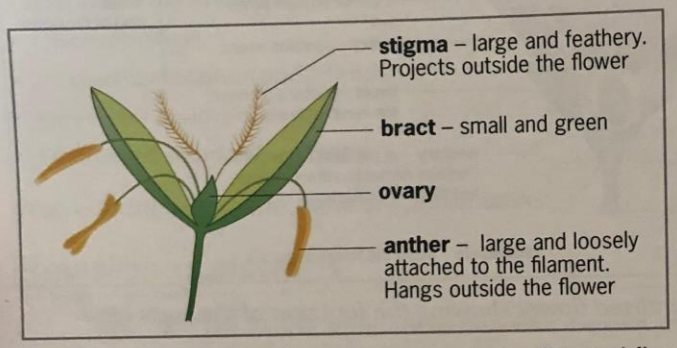
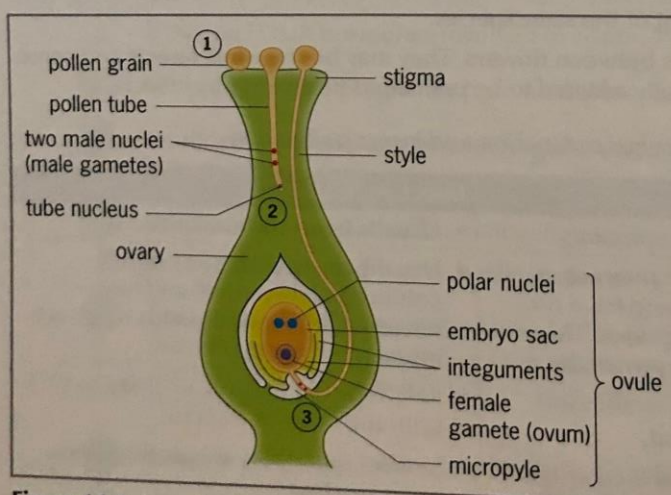


Figure 14.7 *Generalised structure of a wind pollinated flower*

Fertilisation in flowering plants

After pollination has occurred, the male gamete then has to reach the female gamete for **fertilisation** to take place.



① A **pollen grain** lands on the **stigma**. It absorbs nutrients present, swells and develops a **pollen tube**.

② The **pollen tube**, with two **male nuclei** and a **tube nucleus** in its tip, grows down through the **style** by secreting digestive enzymes that digest a pathway.

③ The **pollen tube** grows through the ovary wall and through the **micropyle** of the ovule and bursts. The tube nucleus degenerates, and one male nucleus fuses with the female gamete to form the **zygote**. The other male nucleus and the two polar nuclei fuse to form the **endosperm**.

Figure 14.8 *Longitudinal section through a carpel showing the mechanism of fertilisation*

Events following fertilisation in flowering plants

Seed development

After fertilisation, each **ovule** develops into a **seed**:

- The **zygote** divides by **mitosis** forming the **embryo** which develops into three parts:
  - the **plumule** or embryonic shoot
  - the **radicle** or embryonic root
  - **one cotyledon** or seed leaf in monocotyledons or **two cotyledons** in dicotyledons (see Figure 13.2, page 114).
- The **endosperm** remains in **endospermic seeds**, e.g. maize and castor oil, but is absorbed by the cotyledons in **non-endospermic seeds**, e.g. green bean and pigeon pea. In endospermic seeds, the endosperm stores food; in non-endospermic seeds, the cotyledons store food.
- The **integuments** become dry and develop into the **testa**, and the **micropyle** remains in the testa.

Water is withdrawn from the seed and it becomes **dormant**.

Fruit development

After fertilisation, the **ovary wall** develops into the **fruit**. A fruit contains one or more **seeds**; the number depends on the number of ovules in the original ovary that were fertilised. The **shape** and **structure** of many fruits is very similar to the original ovary.

The **stigma**, **style**, **stamens** and **petals** wither and drop off. The **sepals** may drop off or they may remain, e.g. in eggplant.

Fruits

Fruits **protect** the developing seeds and they help to **disperse seeds**. The wall of the fruit is known as the **pericarp** and may be composed of three layers:

- the **exocarp (epicarp)** or outer layer
- the **mesocarp** or middle layer
- the **endocarp** or inner layer.

There are two main **types** of fruits:

- **Succulent (fleshy) fruits**. One or more layers of the pericarp are fleshy and juicy, e.g. mango, guava, tomato and cucumber.
- **Dry fruits**. The pericarp is thin and dry, e.g. the pod of pride of Barbados or pigeon pea and the capsule of castor oil.

A **fruit** has **two** scars, one where it was attached to the parent plant and one where the style was attached. A **seed** only has **one** scar, the hilum, where it was attached to the fruit.

Seed dispersal

Fruits aid in **dispersing** seeds. Spreading seeds away from the parent plant is important to increase the chances of survival.

- Dispersal prevents **overcrowding** thereby preventing competition for light, water, carbon dioxide and minerals.
- Dispersal allows plants to **colonise** new habitats.

Dispersal by wind

- Some small **dry fruits** develop one or more **wing-like** extensions, e.g. crow and *Combretum*, or the **seeds** contained in certain fruits develop one or more **wings**, e.g. mahogany and *Tecoma*. These provide a large surface area to help the wind carry the fruits or seeds.

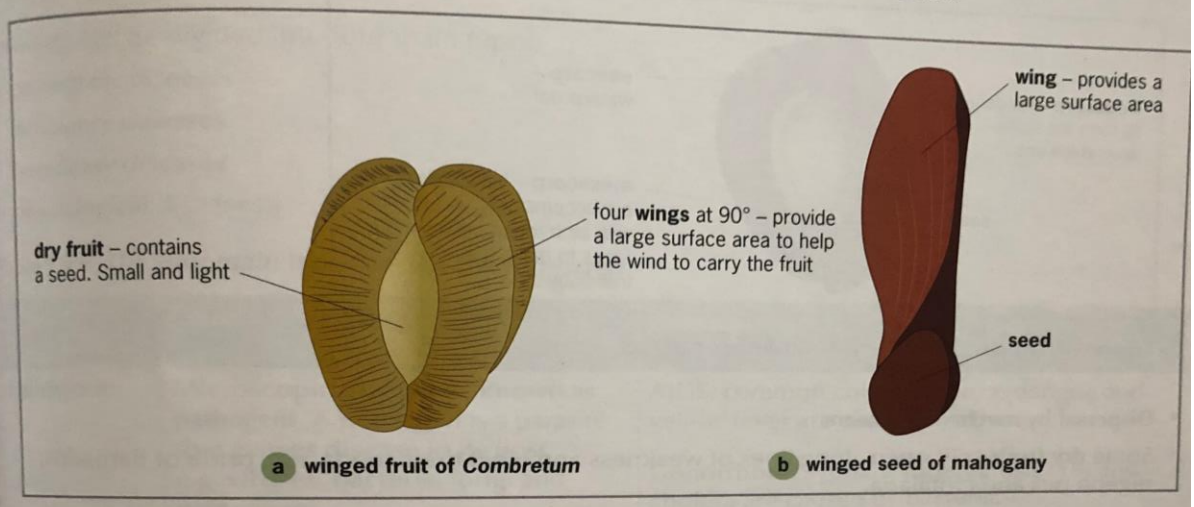


Figure 14.11 *Winged fruits and seeds*

- Some small **dry fruits** develop **hair-like** extensions that form a 'parachute', e.g. *Tridax*, or the **seeds** contained in certain fruits develop a 'parachute' of **hairs**, e.g. *Stephanotis*, cotton and silk cotton. These provide a large surface area to help the wind carry the fruits or seeds.

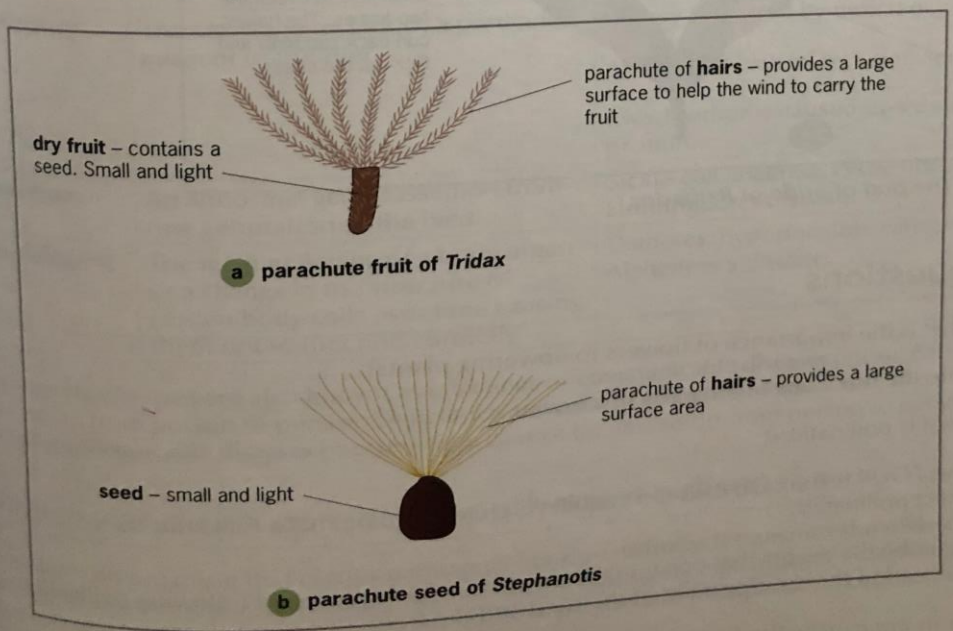


Figure 14.12 *Parachute fruits and seeds*

Dispersal by water

Some **succulent fruits** develop a waterproof exocarp and become **buoyant** so they can float on water, e.g. coconut and manchineel.

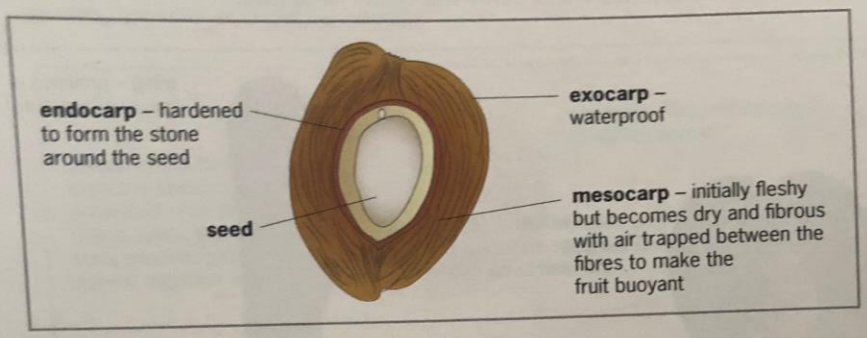


Figure 14.13 *The succulent fruit of coconut*

- **Dispersal by mechanical means**

  Some **dry fruits** split open along lines of weakness and eject their seeds, e.g. pride of Barbados, pigeon pea and crotalaria.

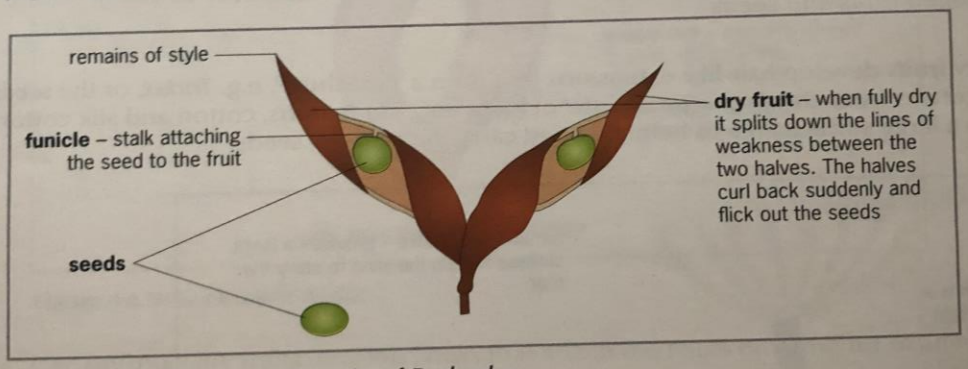


Figure 14.14 *The pod of pride of Barbados*

Revision questions

10 What is the importance of flowers to flowering plants?

11 State the functions of the parts of a flower.

12 What is pollination?

13 Give FOUR features that would enable you to determine that a flower is insect pollinated.

14 Describe the events that occur in the carpel of a flowering plant following pollination that lead to the development of the seed and the fruit.

15 Plants are usually the first organisms to colonise new environments even though they cannot move from place to place by themselves. Explain, giving specific examples, the different ways plants can arrive in new environments.