Chapter 16
Male and female

Unit
1B

Unit content

Body systems
Organs within systems are organised for efficient functioning and interaction. Males and females have different body forms and reproductive systems.

Reproduction:
- general structural and functional differences between male and female reproductive systems
- differences between males and females *e.g. growth rates, strength and perceptions*.

Figure 16.1 One of the many differences between males and females is their body shapes

The joining of a male and a female sex cell results in the formation of a new individual and the continuation of the human species.

Organisms that reproduce sexually produce male and female sex cells, or gametes. A male gamete and a female gamete join at fertilisation to form a new cell, the zygote. From the zygote develops the multicelled organism. Thus, offspring that are produced sexually originate from the cells of both the male and the female parent. In humans, as in all other mammals, males and females have different roles in reproduction. The human male and female reproductive systems (described in Chapter 15) enable the male and female sex cells to be brought together efficiently.

The male role in reproduction

The main role of the male in reproduction is to produce the male gametes, or sperm, and to deposit these sperm inside the female so that fertilisation can take place. It is important that there are sufficient numbers of sperm to survive the journey to the egg, and, once there, sufficient numbers of sperm to break through the protective layer of cells that surround the egg.

Sperm production

See an animation of spermatogenesis at http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter28/animation__spermatogenesis__quiz_1_.html

The male sex organs are the two testes and each contains huge numbers of tubules (see Chapter 15 and Fig. 15.3). Each tubule is lined with cells that divide in a process called **spermatogenesis** to produce the male gametes. Figure 16.2 describes the process of spermatogenesis.

Human sperm are extremely small, being only about 0.06 mm long. Each is made up of a head, neck, middle piece and tail. Figure 16.3 shows the parts of a sperm and their functions.

Sperm transfer

The production of the male gametes is only part of the male's role in reproduction. It is also his role to transfer sperm to the female so that a sperm can unite with an egg.

For sperm to be deposited in the vagina sexual intercourse needs to take place. Chapter 15 described how the penis becomes erect so that it can be inserted into the vagina of the female.

Stimulation of the penis results in **ejaculation**—rhythmic contractions that push the semen out of the body. The semen that is ejaculated is deposited in the vagina at the entrance of the uterus (see Fig. 15.7).

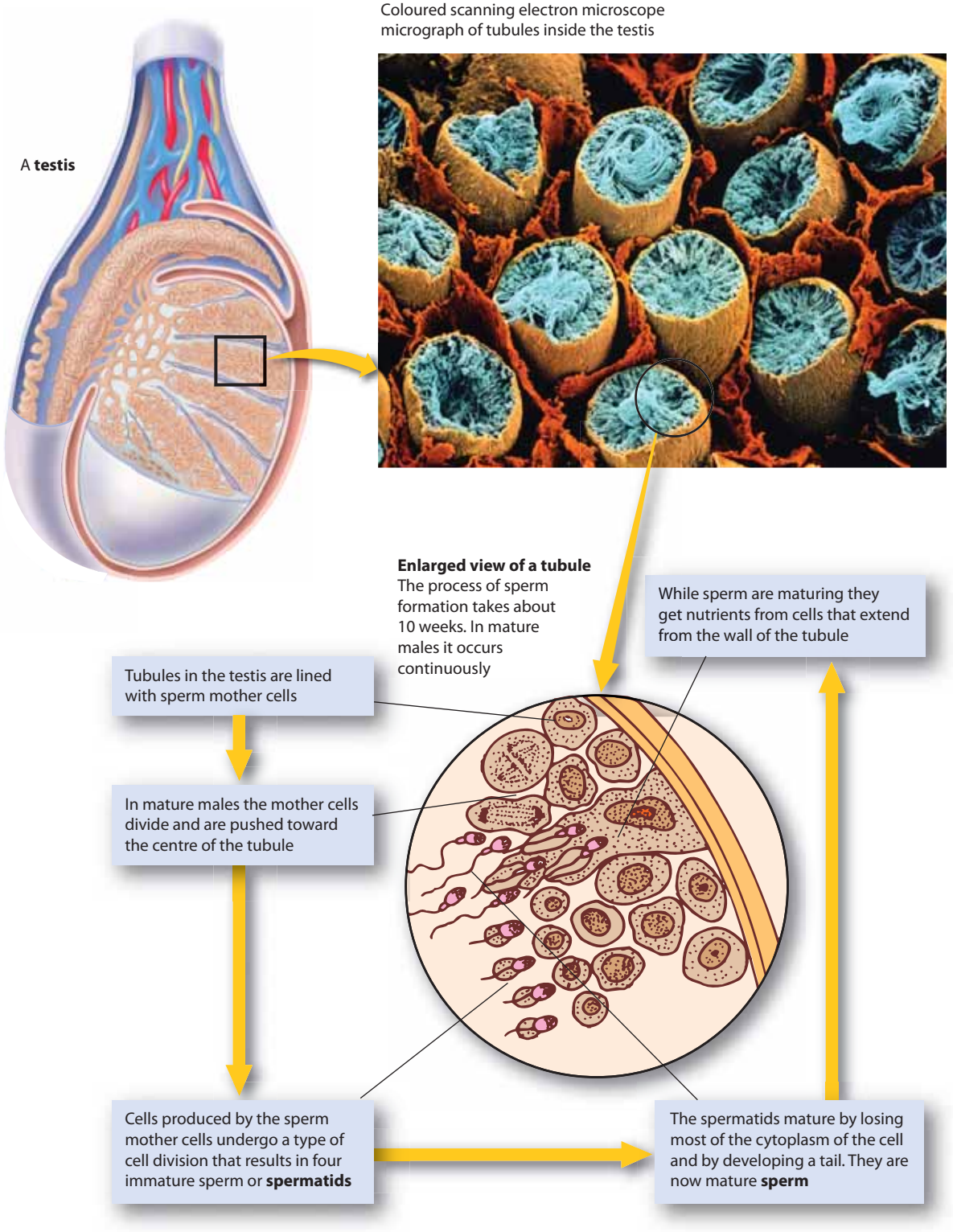


Figure 16.2 Section through a testis, showing spermatogenesis within a tubule

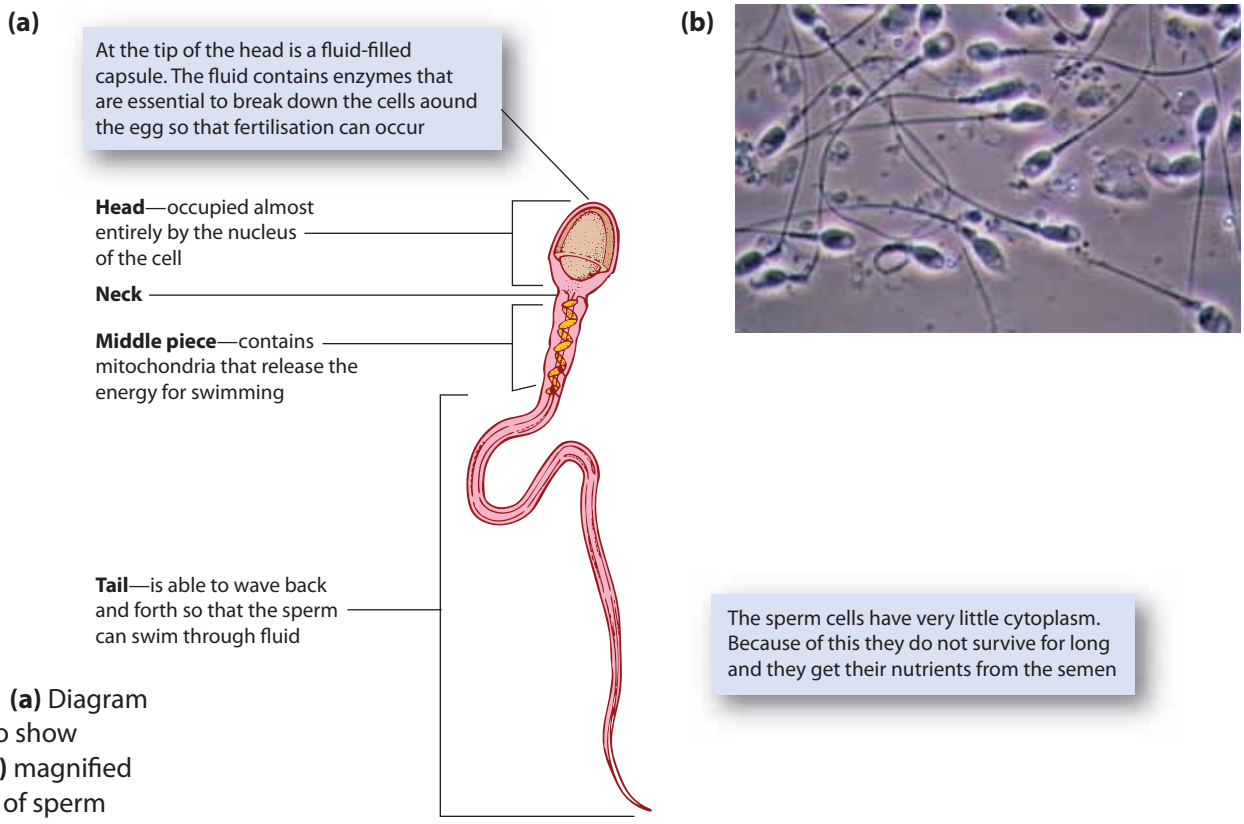


Figure 16.3 **(a)** Diagram of a sperm to show structure; **(b)** magnified photograph of sperm

The female role in reproduction

Human females have a greater role to play than males in ensuring the production of the next generation. Females not only produce eggs but, if fertilisation is successful, they also carry the developing baby within their bodies.

Egg production

In females the two ovaries produce the female gametes, the **ova** (or eggs). Chapter 15 describes how each ovary has a layer of germ cells, each of which is enclosed in a follicle. Some of these follicles eventually mature, move to the surface of the ovary and burst, expelling an egg.

The production of eggs within the ovaries is called **oogenesis** (see Fig. 16.4).

Figure 15.6 on page 185 shows the formation of the follicle within the ovary and how the egg is released from the follicle at ovulation.

The events of oogenesis are very similar to those of spermatogenesis. The main difference is that in females oogenesis produces a single large egg from each original cell, while in the male, spermatogenesis produces four very small sperm from each original cell.

Fertilisation

When the semen is ejaculated into the vagina it contains hundreds of millions of sperm. Very large numbers of sperm are required due to their high death rate as they swim through the uterus and into the uterine tubes. Only a few thousand reach the

Egg mother cells develop in the ovaries before a female baby is born

The egg mother cells grow to become **primary oocytes**. This process also takes place before birth

Each primary oocyte becomes surrounded by a single layer of cells called a **follicle**. When a female becomes sexually mature some follicles begin to grow and mature

A primary oocyte divides producing one large cell, the **secondary oocyte** and one smaller cell called the polar body

The secondary oocyte divides again producing one large cell, the **egg** and another small **polar body**. The polar bodies die but the egg can be fertilised and develop into a new human

Usually only one follicle completes its development each month and only one egg is released

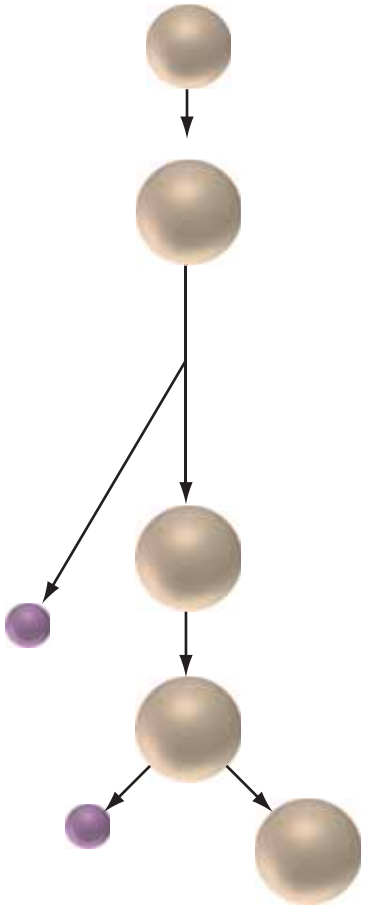


Figure 16.4 Oogenesis

uterine tubes. If the sperm meet an egg about one-third of the way down the tube, then fertilisation may occur (see Fig. 15.8 on page 186).

The joining of a sperm and an egg at fertilisation means that the fertilised egg, the zygote, has chromosomes and genes from both the male parent and the female parent.

An animation of oogenesis can be seen at http://wps.aw.com/bc_martini_eap_4/40/10469/2680298.cw/content/index.html

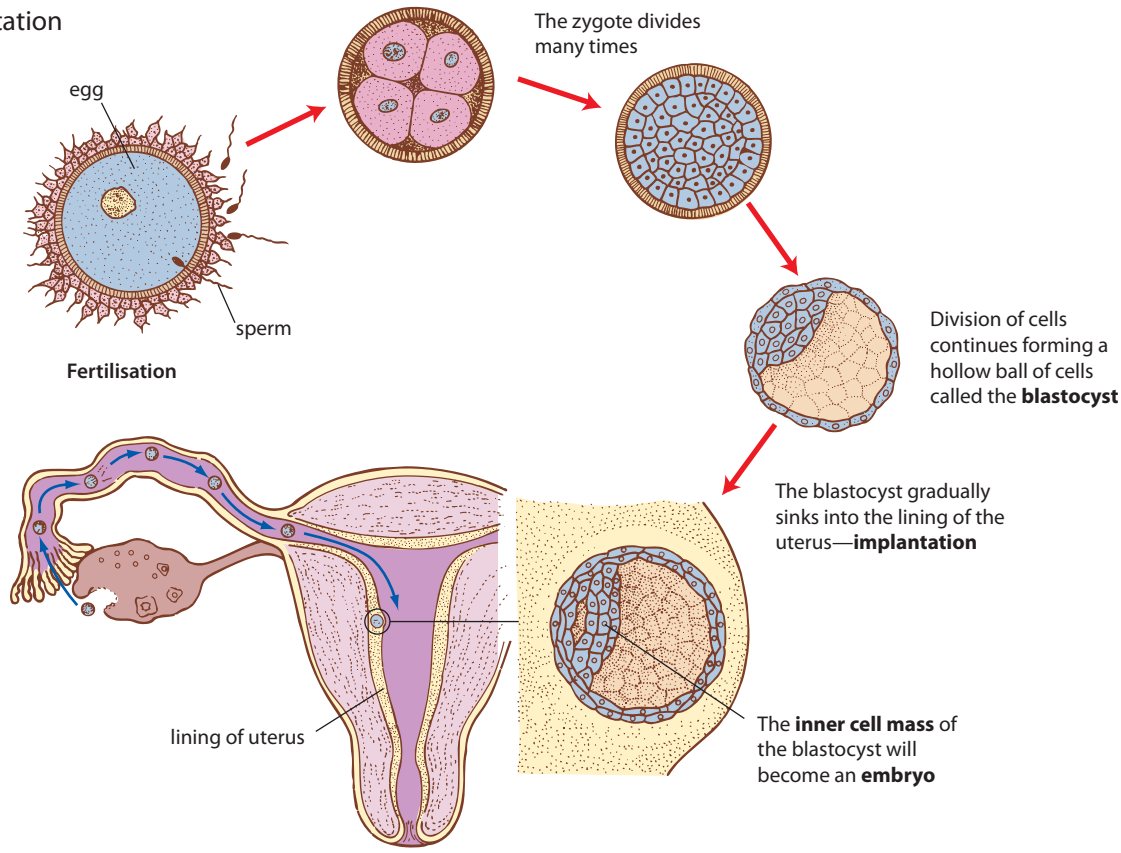
Pregnancy

After fertilisation the zygote continues to travel down the uterine tube until it reaches the uterus. As it does so, it divides many times. By the time it reaches the uterus it is a hollow ball of cells called a **blastocyst**. This journey takes about five days.

The blastocyst remains within the hollow cavity of the uterus for two to three days, and then gradually sinks into the soft lining. This process is called **implantation**.

The blastocyst is made up of a thin layer of cells surrounding a space filled with fluid. On one side of the blastocyst is a group of cells called the **inner cell mass** (see Fig. 16.5). These cells will develop into the **embryo**. The term embryo is used to describe the developing baby during the first two months of pregnancy. The remainder of the blastocyst develops into special membranes that will surround and protect the embryo. Part of one of these membranes is the **placenta**. The placenta is the organ that allows oxygen and nutrients to pass into the baby's blood. It also allows wastes to pass from the baby's blood into the mother's blood. In the placenta the blood of the embryo and the blood of the mother are very close together but they do not mix. A few layers of cells separate the two blood supplies.

Figure 16.5 Implantation



View a week-by-week description of a baby's development during pregnancy at http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Pregnancy_week_by_week?Open

The placenta is attached to the baby by the **umbilical cord**. It contains two **umbilical arteries** that carry blood containing wastes to the placenta from the baby. A single **umbilical vein** carries oxygen-rich blood from the placenta to the baby.

By the end of the second month of pregnancy all of the baby's organs are in place and the placenta is fully functional. From this time on the developing baby is called a **foetus**.

During the period from the ninth week through to birth, the foetus grows from around 3 cm in length to 50 cm. Its increase in weight is even more dramatic, from around 4 g to over 3 kg. While these increases are taking place, the body

Figure 16.6 The external appearance of the foetus from Week 9 through to full term

proportions are also changing. The head becomes proportionately smaller as the limbs become longer (see Fig. 16.6). This increase in the size of the foetus also has a visible effect on the mother. During the fourth month her uterus expands and her abdomen begins to bulge (see Fig. 16.7).

By the end of the fifth month the mother can feel movements of the foetus, such as kicking and turning; by the end of the seventh month, these movements are quite strong. However, as the pregnancy approaches the time for birth, the activity becomes much less because the foetus now occupies all the available space in the uterus.

By the fortieth week of pregnancy the foetus has changed its position to lie with its head resting inside the curved shape of the uterus. The baby is now ready to be born (see Fig. 16.8).

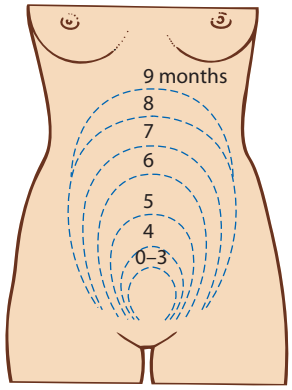


Figure 16.7 The size and position of the uterus at various stages of pregnancy

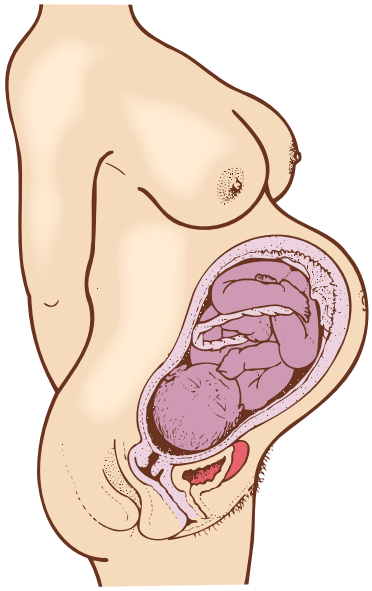


Figure 16.8 Pregnancy: just before birth

Birth

When the baby is ready to be born hormones from the mother, and possibly also from the baby, stimulate the muscles of the mother's uterus to begin contracting. The contractions gradually become stronger and more frequent, pushing the baby towards the opening of the uterus. Helped by voluntary contractions of the mother's abdominal muscles the baby is pushed through the cervix and through the vagina. After the baby is born the uterus continues to contract, pushing out the placenta and the membranes that were around the baby. These are called the **afterbirth**. The umbilical cord is clamped and cut. A new human life has begun.

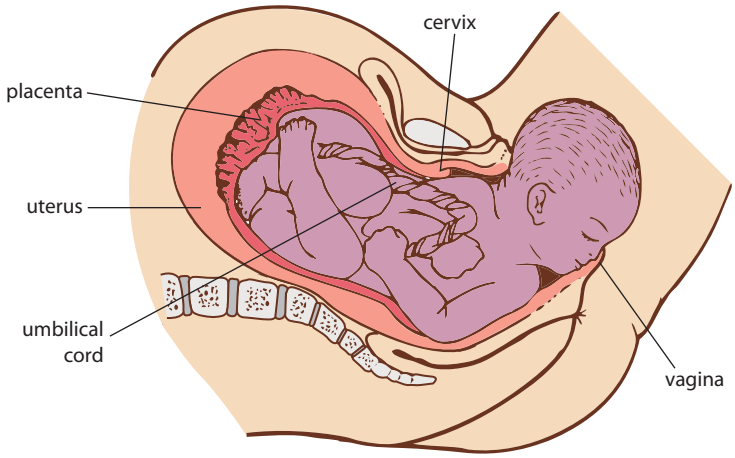


Figure 16.9 Childbirth

Milk production and breastfeeding

During childhood, the breasts of both males and females are very similar. However, from around the age of 10 or 11 in females, the breasts begin to develop. This development results in the formation of milk-secreting structures. Fine tubes called **ducts** lead to milk spaces where the milk can be stored. Another duct leads from the milk space to the nipple. Because there are many milk spaces, each nipple has between fifteen and twenty-five openings for the secretion of milk.

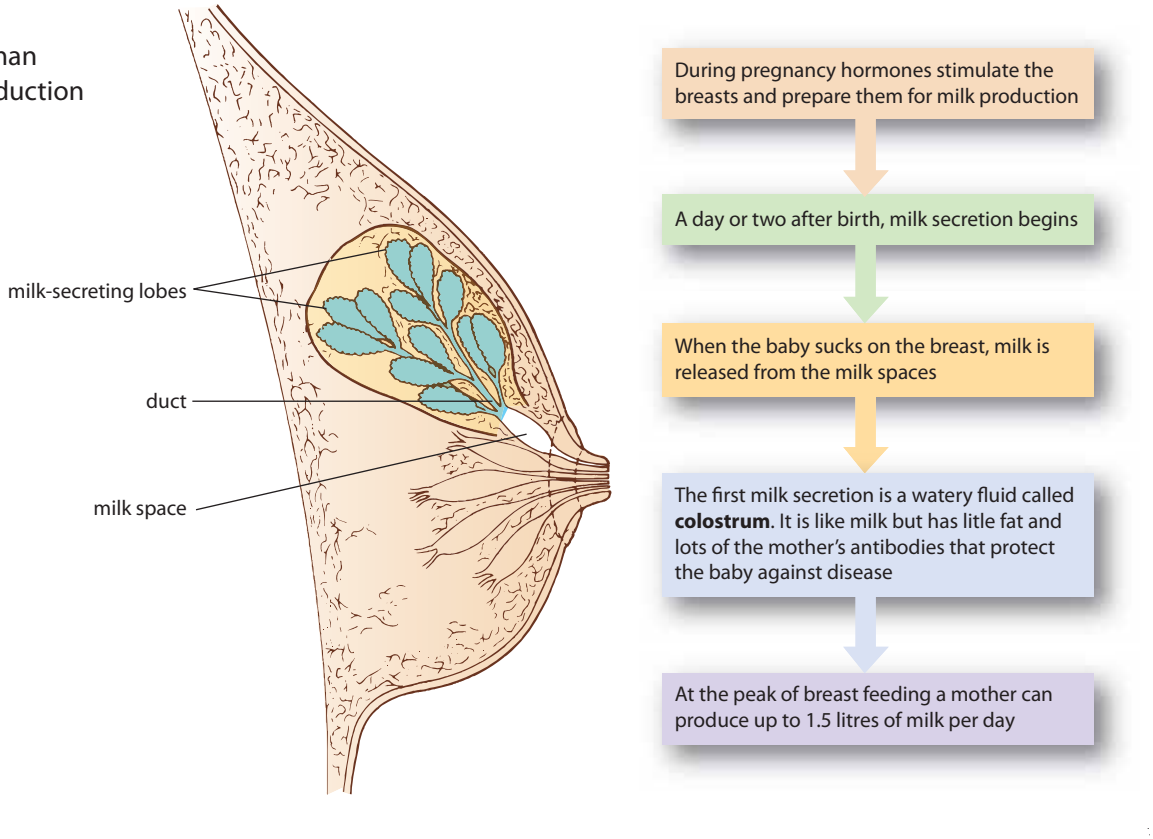


Figure 16.10 The structure of the human breast and milk production

While breastfeeding, a woman needs to ensure that she has a balanced diet. In particular, her diet should contain adequate supplies of calcium, phosphate and vitamin D.

Human milk is the perfect food for the developing infant. It meets all the nutritional needs of a baby for the first six months of life and can be an important food for a further six months. Breast milk provides protein, fat and carbohydrate in just the right amounts that a baby needs. It is thus ideal for the development of babies and infants.

Breastfeeding has many important advantages for both the baby and the mother. For example, obesity is rare in breastfed babies, and the act of breastfeeding builds a strong bond between child and mother. In addition, breast milk contains antibodies, produced by the mother, which give the baby some protection against infections.

Male and female body form

In Chapter 15, adolescence was discussed, along with the changes that take place at puberty. The secretion of sex hormones at puberty in girls results in the breasts beginning to enlarge. At first, the nipple area begins to bulge, with the nipple projecting from the centre. Gradually the breasts become fuller, their actual size dependent on the amount of fatty tissue that is deposited around the lobules. At the same time the hips become broader. The hip bones grow in size and the amount of fatty tissue increases, giving females a much more rounded shape when compared to that of males (see Fig. 16.1 and 16.11).

For boys, the first changes that occur often go unnoticed. These are an increase in the size of the testes and the scrotum. About a year after the testes begin to grow, the penis begins to thicken and become longer.

Accompanying the changes in the reproductive system that have already been discussed, other changes occur in body characteristics. These are called **secondary sex characteristics**—characteristics that are associated with the male or the female, but which are not directly related to reproduction. The secondary sex characteristics that develop during puberty are shown in Table 16.1.

As a result of these changes, including the adolescent growth spurt discussed in Chapter 15, males and females gradually become different in appearance (see Fig. 16.11).

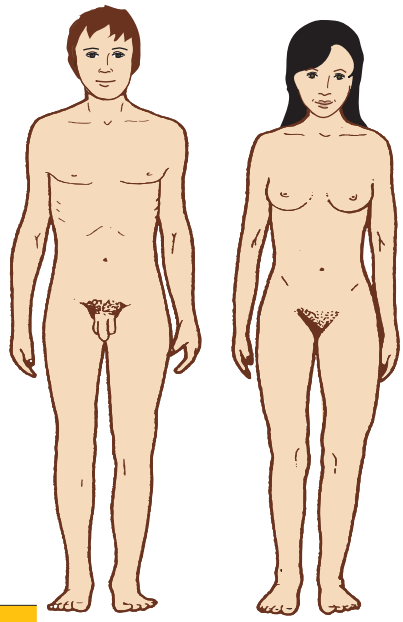


Figure 16.11 The changes during adolescence: male and female body forms are different

Table 16.1 Secondary sex characteristics that develop during puberty

Characteristic	Females	Males
Hair	Pubic hair distribution different from males Hair on limbs	Pubic hair distribution different from females Hair on face, chest, arms and legs
Muscles	Less muscle development than males More fat tissue developed under skin giving more rounded body shape Less muscular strength	Greater size and strength of muscles compared with females Muscles give shape to arms, legs and shoulders
Voice	Gradual deepening of voice Adult voice higher pitched than males	Deepening of voice often occurs more suddenly than females—the voice 'breaks' Adult voice lower pitched than females
Hips	Hips become wider and rounder because the pelvis enlarges Development of fat under the skin gives rounded shape to hips	Hips remain narrow and more angular
Breasts	Nipples enlarge and protrude Breasts become larger and rounder	Little breast development
Adult body shape	Narrower shoulders Wider hips Shorter limbs (legs 52% of body height) Average height of young adult females in Australia was 164 cm*	Wider shoulders Narrower hips Longer limbs (legs 56% of body height) Average height of young adult males in Australia was 178 cm*

*Australian Bureau of Statistics, National Nutrition Survey, 1995

As Table 16.1 and Figure 16.11 show, by the time the body form is mature, males and females usually look very different from each other. In particular, most males have a larger amount of muscle mass than most females. Males, on average, have muscle fibres that are larger than those in females, and they shape the arms, legs and shoulders. On the other hand, females usually have a greater amount of body fat, giving them a more rounded shape. Females tend to have, on average, 25% body fat compared to 15% in males. The greater amount of muscle in most males gives them greater strength when doing tasks requiring muscular effort.

Working scientifically

Activity 16.1 Sexual stereotyping

Sexual stereotyping refers to the assumption that individuals have certain roles, or carry out certain activities, based on whether they are male or female. Parents have an important role in moulding the development of their children, and especially in sex stereotyping. As a class group, brainstorm a list of patterns of behaviour that parents may encourage:

1. in girls, but not in boys
2. in boys, but not in girls.

After generating your list have a class discussion, or debate, on the role of parents in the sexual stereotyping of their children.

Activity 16.2 Age, sex and development

What to do

Draw up a table in which to record the age, sex, height and weight of about thirty students. Discuss with others, or with your teacher, how to draw the table so that all the data can be included. With the permission of their teacher, and the cooperation of a Year 7 or 8 class, measure the height and weight of each person in the class. Record the measurements in your table along with the sex and age in years and months (which you can determine from the date of birth).

Studying your data

1. Decide on a way to group your data so that you can calculate average heights and weights for boys and girls in age groups.
2. Draw graphs of average height and weight against age for each sex. Draw your graphs in such a way that you can easily compare boys and girls.
3. What physical differences are there between the male and female members of the class you surveyed?
4. Are there any patterns of development that appear to be related to age?
5. If you are able, or if you have time, you could compare heights and weights in a Year 6, 7, 8 and 9 class. You may then be able to decide when the adolescent growth spurt occurs (on average) for girls and boys in your community.

REVIEW QUESTIONS

1. **(a)** What is the role of the male in reproduction?
   (b) Describe the reproductive organs of the male that enable him to carry out his role in reproduction.
2. Draw a sperm, label the main parts and describe the function of each part.
3. **(a)** What is the role of the female in reproduction?
   (b) Describe the reproductive organs of the female that enable her to carry out her role in reproduction.
4. **(a)** What is spermatogenesis?
   (b) Describe what happens during spermatogenesis.
5. **(a)** What is oogenesis?
   (b) Describe what happens during oogenesis.
6. Describe what happens when fertilisation occurs.
7. What is implantation? Describe what happens during implantation.
8. What is the placenta? Why is the placenta important during pregnancy?
9. **(a)** What is colostrum?
   (b) How does colostrum differ from milk?
10. **(a)** What are 'secondary sexual characteristics'?
    (b) Briefly describe the differences between the secondary sexual characteristics of boys and of girls.

APPLY YOUR KNOWLEDGE

1. Discuss how the roles of the male and female in producing a child are similar, and how they differ.
2. As the foetus grows within the uterus the female's abdomen begins to bulge. Describe what you think would happen to the internal organs that are close to the expanding uterus.
3. Suggest some of the factors that may influence a woman in reaching a decision on whether to breastfeed or bottle-feed her baby.
4. A couple had sexual intercourse but the female did not become pregnant. List all the reasons that you can think of for pregnancy not occurring.
5. Imagine that the government of a small African country is concerned that many mothers are not breastfeeding their babies. Use reference material to find out the major benefits of breastfeeding. With this information, prepare a leaflet that could be given to the women of this country to try to convince them of the benefits of breastfeeding.
6. Females have relatively more body fat than males, and less muscle mass. As a consequence, female sporting prowess has often been overshadowed by that of males. For example, the marathon for women was only added to the events in the Olympic Games in 1984. Find out what changes occur in males during adolescence that result in their greater muscle mass and strength.