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Answers

Chapter 11 The structure of the reproductive systems allows reproduction

Questions 11.1

Recall knowledge

**1** List the primary sex organs.

Answer*:* The primary sex organs are the gonads: in males these are the testes, in females the ovaries.

**2** State the function of each of the following structures of the male reproductive system:

**a** seminiferous tubules

Answer*:* The cells lining the seminiferous tubules produce the male gametes.

**b** epididymis

Answer*:* The site where the sperm mature

**c** interstitial cells of the testis

Answer*:* These cells produce testosterone, the male sex hormone.

**d** vas deferens

Answer*:* The tube that carries the sperm away from each testis.

**e** urethra.

Answer*:* In males the urethra has two functions, to carry urine from the bladder and to carry semen.

**3** List the glands that produce secretions in the semen.

Answer*:* Seminal vesicles, prostate gland, bulbourethral glands

**4** State the alternative name for the

**a** egg

Answer*:* Ova (ovum singular)

**b** uterine tube.

Answer*:* Fallopian tube

**5** List the structures, in order, that the ova pass through from the ovary to the exterior of the body.

Answer*:* ovary → fimbriae → fallopian tube → uterus → cervix → vagina

Apply knowledge

**6** Explain why the scrotum is divided internally.

Answer*:* There are two internal sacs to house each testis.

**7** Explain why the muscles in the wall of the scrotum relax during hot weather.

Answer*:* Sperm production requires a temperature about 2oC below normal body temperature. On hot days, the muscles in the scrotum wall relax to move the testes further away from the body to keep them cooler.

**8** Explain the processes that guide the egg through the uterine tubes.

Answer*:* The presence of the fimbriae help guide the ovum into the uterine tubes. The uterine tubes are lined with cilia and along with the contraction of the smooth muscle of the uterine tubes, the ovum is propelled towards the uterus.

Questions 11.2

Recall knowledge

**1** List the two types of gametogenesis, and state where they occur.

Answer*:* Spermatogenesis – in the testes and oogenesis, in the ovaries.

**2** Define each of the following:

**a** spermatogonia

Answer*:* Spermatogonia are immature sperm cells, or sperm mother cells (2*n*)

**b** diploid

Answer*:* A cell where the chromosomes occur in pairs, the full complement of chromosomes. (2*n*)

**c** spermatids

Answer*:* Haploid cells produced from spermatogonia by meiosis, they mature to form spermatozoa.

**d** primary follicle

Answer*:* A primary oocyte surrounded by a single layer of cells, dormant within the ovary.

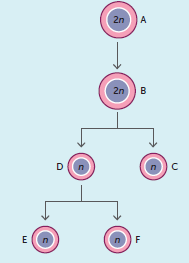
**e** first polar body.

Answer*:* The smaller of the two unequal cells formed when the primary oocyte divides during the first division of meiosis.

**3** Draw a labelled diagram of a sperm.

Answer*:* Refer to Figure 11.9 on page 282 of the student book.

**4** Label the structures on the diagram modelling oogenesis.



Answer:

A – oogonium

B – primary oocyte

C – first polar body

D – secondary oocyte

E – ootid

F – second polar body

**5** State how many:

**a** sperm are produced from a single spermatocyte

Answer: Four

**b** ova are produced from a single primary oocyte.

Answer: One

**6** Name the structures formed, in order, during spermatogenesis.

Answer: Spermatogonium → primary spermatocyte → secondary spermatocyte → spermatids → spermatozoa

Apply knowledge

**7** Describe two similarities and two differences between spermatogenesis and oogenesis.

Answer*:* Similarities: Both start with diploid cells, both result in haploid cells that differentiate into gametes, both occur in the gonads, both use mitosis and meiosis

Differences: Spermatogenesis produces four haploid cells, oogenesis produces one haploid ootid and up to three polar bodies, oogenesis does not fully complete meiosis unless fertilisation occurs whereas spermatogenesis does.

**8** Explain the relationship, and differences, between a spermatid and a sperm.

Answer*:* A spermatid is an immature sperm cell. When the spermatid undergoes maturation the cell changes shape, losing much of its cytoplasm and a tail is produced.

Questions 11.3

Recall knowledge

**1** How are hormones transported around the body?

Answer*:* Through the blood stream

**2** Name the gonadotrophic hormones.

Answer*:* Follicle stimulating hormone (FSH), luteinising hormone (LH), oestrogen, progesterone.

**3** State the effect of:

**a** follicle-stimulating hormone

Answer*:* Stimulates the development and maturation of the ovarian follicle in females. Stimulates the production of sperm in males.

**b** luteinising hormone

Answer*:* Promotes the final maturation of the ovarian follicle, ovulation and the formation of the corpus luteum in females. In males it stimulates the secretion of testosterone.

**c** prolactin

Answer: Affects the breasts, and along with other hormones prepares and maintains milk production.

**d** oxytocin

Answer*:* Causes uterine contraction, promotes the movement of milk in the breast and has a role in the movement of sperm and the production of testosterone in the testes.

**e** progesterone

Answer*:* Maintains the endometrium, and the development and maintenance of the placenta. In breasts, progesterone effects the development of milk-secreting glands.

**f** oestrogen

Answer*:* Oestrogen affects the development of the female reproductive system, the development of secondary sexual characteristics.

**g** testosterone.

Answer*:* Testosterone affects the development of the male reproductive system, and the development of secondary sexual characteristics.

**4** How long is the ovarian cycle?

Answer*:* 28 days on average.

**5** Describe the events of the ovarian cycle.

Answer: The ovarian cycle starts with the primary follicle, where follicle stimulating hormone and luteinising hormone stimulate the follicle cells to divide and enlarge. Secretions from these follicle cells create a fluid-filled space that moves the egg to the edge of the follicle; at this point it is now referred to as a secondary follicle. As more fluid accumulates within the follicle, it gradually moves towards the edge of the ovary. When it reaches the edge, it produces a bulge on the surface of the ovary and is now referred to as a mature ovarian follicle (Graafian follicle). Ovulation occurs when the mature follicle bursts and the ovum is released. The ruptured follicle collapses and forms the corpus luteum.

**6** Describe a corpus luteum.

Answer*:* The corpus luteum is a cream-coloured body, formed from the ruptured follicle cells and the blood clot. The corpus luteum secretes hormones responsible for the development of the lining of the uterus.

**7** With reference to the ovarian cycle, when does menstruation usually start?

Answer*:* Menstruation occurs around 14 days after ovulation.

**8** List the secondary sexual characteristics of:

**a** males

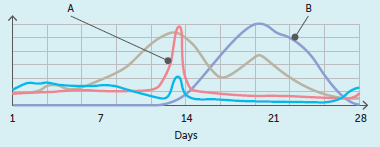
Answer*:* Growth of body hair including pubic hair, a more obvious deepening of the voice due to the growth of the larynx, growth in stature, broader shoulders.

**b** females.

Answer*:* Development of breasts, broadening of hips, growth of pelvic bones and the deposition of fat around the hips. Pubic hair and hair in the armpits, slight deepening of the voice.

Apply knowledge

**9** Name the hormones labelled A and B on the graph below. Explain how you determined the answer.



Answer*:* A – Follicle Stimulating Hormone – FSH is high just before ovulation as its role is to promote growth and mature the follicle. It rapidly falls after ovulation, as the levels of oestrogen rise.

B – Oestrogen – is higher after ovulation because it is produced by the corpus luteum. The presence of oestrogen also limits the action of FSH and LH which prevents other follicles from maturing.

**10** Explain the difference between a primary follicle and a secondary follicle.

Answer*:* A primary follicle is dormant and immature and has been present in the ovaries since birth. Its development is paused at prophase I in meiosis until puberty. A secondary follicle has been affected by the hormones of FSH and LH, the surrounding cells have become larger and secrete a fluid, forcing the follicle towards the surface of the ovary. The first meiotic division is completed in a secondary follicle.

**11** The ovarian cycle ceases during pregnancy. Explain how this is regulated.

Answer*:* If pregnancy occurs, the corpus luteum does not break down and continues to produce oestrogen and progesterone, which prevents the secretion of FSH and LH to mature another follicle. Another hormone, namely human chorionic gonadotrophin (HCG), also maintains the corpus luteum until the placenta is fully developed and starts to secrete oestrogen and progesterone.

**12** Suggest why menstruation needs to happen in female humans.

Answer*:* Menstruation is the shedding of the endometrium and uterine bleeding. It needs to occur every 28 days, so that when ovulation occurs again, there is a repaired and thick uterine lining ready to receive the potential fertilised ovum. If menstruation did not occur regularly, the uterine lining would not be able to receive a fertilised ovum and implantation could not occur.

**13** Explain how the body ensures that ovulation takes place when a follicle is large enough.

Answer*:* The levels of LH and FSH have been gradually increasing during the development and maturation of the follicle, ensuring the follicle is large enough and is pushed against the surface of the ovary. The levels of FSH and LH spike just prior to ovulation.

Chapter 11 activities

Activity 11.1 Investigating the female and male reproductive systems

Studying your observations

**1** Draw a diagram of your dissections, labelling all the structures that you have identified.

Answer*:* Refer to dissection diagrams on page 293 and 294 of the student book.

**2** On your diagram, use arrows to show:

**a** the path an egg would take after it has been expelled from the ovary.

Answer*:* The arrow should run from the ovary down the fallopian tube towards the uterus.

**b** the path that the sperm and semen would follow as they travel to the tip of the penis.

Answer*:* The arrow should start at the epididymis, run along the vasa deferentia, past the seminal vesicles and through the prostate gland before entering the urethra towards the tip of the penis.

**c** the path that you think the sperm and semen would take after they have been deposited in the vagina.

Answer*:* The arrow should show the movement of sperm and semen entering the cervix and moving up the two horns of the uterus.

**3** List any differences between the reproductive structures of a female rat and a female human.

Answer*:* The rat has two uteri, humans only one; rat uteri are very elongated, humans relatively short; rats have five to seven pairs of mammary glands, humans have one pair; the rat’s uterine tubes are very short compared with that of a human.

**4** Of the differences you have noted, which ones are related to the rat having a number of offspring at one time?

Answer*:* All the above differences are related to multiple offspring – two long uteri to accommodate many embryos; short uterine tubes because the uteri are so long; and many mammary glands to feed multiple offspring.

**5** List any differences between the reproductive structures of a male rat and a male human.

Answer*:* Male rats have the same organs as humans. The differences are in the relative sizes.

Activity 11.2 Observing the ovary

Studying your observations

**1** Draw a diagram of what you viewed on the slide, labelling all visible structures.

Answer*:* Students should draw a simplified diagram similar to Figure 11.16 on page 287 of the student book.

**2** Compare your drawing with Figure 11.16. If there were there any structures you were unable to see on the microscope slide, annotate your diagram using information from Figure 11.16.

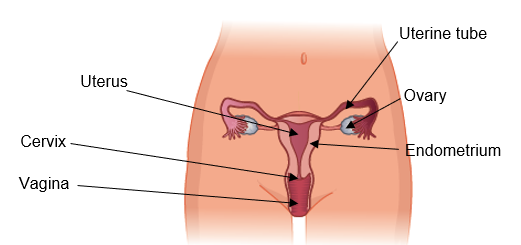
Answer*:* Students should refer to Figure 11.16 on page 287 and annotate their diagrams accordingly.

Chapter 11 review questions

Recall

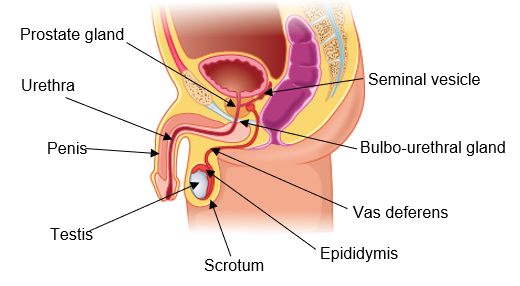
**1** Label the uterus, cervix, ovary, endometrium, uterine tube and vagina on the diagram below.

Answer:



**2** Label the testis, scrotum, penis, vas deferens, epididymis, urethra, prostate gland, bulbo-urethral glands and seminal vesicles on the diagram below.

Answer:



**3** Describe the internal structure of a testis, including the location of sperm production.

Answer*:* Each testis is divided into approximately 200–300 lobes containing the seminiferous tubules (a series of fine tubes). The cells lining the seminiferous tubules are responsible for gamete production. The seminiferous tubules from each lobe join to form a straight tubule, which then joins adjoining straight tubules to form a duct. These ducts then leave the testes to join the epididymis.

**4** Describe how the ovaries are held in position in the pelvic cavity.

Answer*:* The ovaries are held in the pelvic cavity by bands of fibrous tissue called ligaments.

**5** State the function of each of the following structures:

**a** uterine tubes

Answer*:* The function of the uterine tubes is to carry the egg from the ovary to the uterus. They also allow sperm to swim towards the egg, and then allow passage of the fertilised egg to the uterus for implantation.

**b** cervix

Answer*:* The function of the cervix is to act as the neck of the uterus. It is where semen is deposited and will dilate to allow expulsion of the baby during labour.

**c** seminiferous tubules

Answer*:* The function of the seminiferous tubules is to hold the cells that produce the male gamete.

**d** prostate gland

Answer*:* The function of the prostate gland is to produce a thin, milky, alkaline fluid that forms part of the semen.

**e** urethra

Answer*:* In males and females the urethra serves to carry urine from the bladder to outside the body. In males it also serves to carry the sperm and semen out of the body during ejaculation.

**f** endometrium.

Answer*:* The endometrium is a soft, mucous membrane that lines the uterine wall. The fertilised ovum embeds into the endometrium and receives protection and nourishment in the early stages of pregnancy.

**6 a** Define ‘target organ’.

Answer*:* A target organ for a hormone is the organ that is affected by that particular hormone.

**b** What are the target organs fortestosterone and follicle-stimulatinghormone?

Answer*:* Testosterone targets many organs, such as the seminiferous tubules in the testes, particularly the male reproductive organs during puberty.

Follicle-stimulating hormone (FSH) targets the follicle of the ovary in females and the seminiferous tubules of the testes in males.

**7** What do the terms ‘menarche’ and ‘menopause’ refer to?

Answer*:* Menarche is the first menstrual period (onset of menstruation).

Menopause is the time when menstrual periods become irregular and eventually cease.

**8 a** What are secondary sexualcharacteristics?

Answer*:* Secondary sexual characteristics are those that are associated with a person’s sex, but not directly involved in reproduction.

**b** Briefly describe the development of secondary sexual characteristics in both males and females.

Answer:

|  |  |
| --- | --- |
| **Female** | **Male** |
| The enlargement of breasts and broadening of the hips (due to pelvic bone growth and fat deposition) | Hair growth in armpits and groin area (darker, thicker, curlier) |
| Hair growth in armpits and groin area (darker, thicker, curlier) | Facial, chest and back hair growth |
|  | Increase in larynx size and lengthening of vocal cords – deepening in voice and voice may break |

**9** List the following events in the order in which they would occur in the female body: ovulation; the endometrium begins to thicken; formation of the corpus luteum; a follicle begins to develop; uterine bleeding; egg travels down the uterine tube; follicle approaches maturity; degeneration of the corpus luteum; breakdown of unfertilised egg; development of the mature follicle; deterioration of the endometrium.

Answer*:* The order in which they would occur is:

1. a follicle begins to develop
2. the endometrium begins to thicken
3. follicle approaches maturity
4. the development of the mature follicle
5. ovulation
6. egg travels down the uterine tube
7. breakdown of unfertilised egg
8. formation of the corpus luteum
9. degeneration of the corpus luteum
10. deterioration of the endometrium
11. uterine bleeding.

**10** What are the primary sex organs of the male? What are their functions?

Answer*:* Primary sex organs of the male: Testes. Function: Production of spermatozoa (sperm) and sex hormones

**11 a** What are gametes?

Answer*:* Gametes are sex cells; the sperm in males and ova in females. Both are haploid (*n*).

**b** Draw a sperm and identify the main parts.

Answer*:* Refer to Figure 11.9 on page 282 of the student book.

**c** Outline the events that take place in spermatogenesis and oogenesis.

Answer:

|  |  |
| --- | --- |
| **Spermatogenesis** | **Oogenesis** |
| Spermatogonia (2*n*) divide by mitosis | Oogonia (2*n*) divide by mitosis |
| Spermatogonia grow/enlarge into primary  spermatocytes (2*n*) | Oogonia grow/enlarge into a primary oocyte (2*n*) |
| Each primary spermatocyte undergoes first meiotic division to become two secondary spermatocytes (*n*) | A primary oocyte undergoes first meiotic division – one of the resulting cells becomes a secondary oocyte (*n*) and the other the first polar body (*n*) |
| The two secondary spermatocytes undergo second meiotic division to form four spermatids (*n*) | The secondary oocyte (*n*) commences the second meiotic division, but stops at metaphase producing a second polar  body (*n*) and an ootid (*n*)  First polar body (*n*) may also undergo the second meiotic division, resulting in two polar bodies (*n*) |
| Spermatids mature into sperm (*n*) | Ootid matures into an ovum (*n*) |

**d** List the differences between the two processes.

Answer:

* Oogenesis produces polar bodies; spermatogenesis does not.
* The second meiotic division in oogenesis stops at metaphase until, at puberty, the process continues one cell at a time; in spermatogenesis the second meiotic division continues until completed.
* Oogenesis of one oogonium produces one gamete; spermatogenesis of one spermatogonium produces four gametes.

**12** List the glands that secrete seminal fluid and describe the function of each.

Answer:

* The seminal vesicles secrete a thick fluid containing sugars to nourish the sperm.
* The prostate gland secretes a thin alkaline fluid in which the sperm can swim.
* The bulbo-urethral glands (Cowper’s glands) secrete clear mucus that acts as a pre-ejaculatory lubricant.

**13** **a** List the stages of the ovarian cycle, using a diagram to illustrate your answer.

Answer:

* Cells forming the wall of the primary follicle begin to enlarge and divide.
* Secretions of these cells create a fluid-filled space.
* The egg is forced to the edge of the follicle to form the secondary follicle.
* The secondary follicle enlarges and moves towards the edge of the ovary to become a mature follicle.
* The mature follicle bursts to release the egg (ovulation).
* The ruptured follicle collapses and forms the corpus luteum.
* If fertilisation does not occur, the corpus luteum degenerates into a fibrous mass known as the corpus albicans.

Refer to Figure 11.16 on page 287 of the student book.

**b** Describe ovulation.

Answer*:* Ovulation occurs when a mature follicle (Graafian follicle) on the surface of the ovary bursts and releases an ovum.

**c** Describe the changes that the corpus luteum undergoes during a normal ovarian cycle.

Answer*:* Once the mature follicle (Graafian follicle) has released the ovum, it collapses, forming a corpus luteum (containing a blood clot). The corpus luteum secretes the hormone progesterone to increase the endometrial lining ready for implantation if fertilisation does occur. If fertilisation does not occur, then the corpus luteum breaks down into scar tissue 8–10 days after ovulation. This fibrous scar tissue is called the corpus albicans and it eventually disappears.

**d** How do these changes differ if pregnancy occurs?

Answer*:* If pregnancy occurs, the corpus luteum continues to develop and secrete the hormone progesterone to maintain the endometrium, aid the development of and maintain the placenta, and to help develop the milk-secreting glands in the breasts. The ovarian cycle stops with pregnancy. The corpus luteum begins to slowly degenerate in the third month of pregnancy but is still present in the ovary at childbirth.

Explain

**14** Why is reproduction necessary for the human species?

Answer*:* Without reproduction we would not replace the members of our population that die. That would result in the end of the species or extinction.

**15** The location of the testes within a scrotum makes them vulnerable to damage. Explain the reason for their location.

Answer*:* Sperm development requires a temperature 2°C lower than core body temperature. Having the testes in a scrotum allows them to be a little cooler than the body. The scrotum also allows the smooth muscle fibres in the wall of the scrotum to contract, bringing the testes closer to the body as environmental temperature decreases. This maintains the sperm at their optimum temperature. When the environmental temperature rises, the smooth muscle fibres in the wall of the scrotum relax and the testes drop away from the body, maintaining the sperm at their optimum temperature.

**16** The seminiferous tubules are highly coiled, and if they were stretched out would be about 800 m in length. Why is such a great length required in the tubules? List as many advantages as you can to support your answer.

Answer*:* The tubules are very long because this provides a greater surface area to be lined with gamete-producing cells. This allows a greater number of sperm to be produced. Increased numbers of sperm in each ejaculation would increase the chance of fertilisation. Although only one sperm fertilises the egg, a huge number of sperm is required for successful fertilisation.

**17** Describe how follicle-stimulating hormone and luteinising hormone regulate the male reproductive system.

Answer*:* Follicle-stimulating hormone stimulates the epithelial tissue of the seminiferous tubules in the testes to produce sperm, while luteinising hormone stimulates cells in the testes to secrete the hormone testosterone**.**

**18** Explain the role of hormones in regulating the ovarian and menstrual cycles.

Answer*:* Follicle-stimulating hormone (FSH) causes the follicle in the ovary to develop and mature.

Simultaneously, oestrogens are secreted from the ovarian follicle. As the level of oestrogen increases in the blood, the secretion of FSH is decreased and another pituitary hormone, luteinising hormone (LH), promotes the final maturation of the ovarian follicle, ovulation and the formation of the corpus luteum.

The corpus luteum secretes progesterone as well as oestrogens, which maintain the endometrium. Increasing levels of progesterone in the blood inhibit the secretion of LH. If fertilisation does not occur, the corpus luteum degenerates and the levels of hormones in the blood decrease. All four hormones are low while the endometrium thins and sheds during menstruation.

Apply

**19** Draw a diagram of the female reproductive system and mark in the:

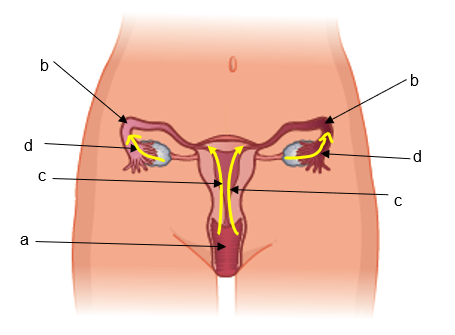
**a** place where sperm are deposited

**b** site where fertilisation takes place

**c** path taken by the sperm to unite with the egg

**d** path the egg follows to unite with the sperm.

Answer:



**20 a** It has been found that men who regularly wear tight-fitting underwear may produce fewer sperm and have reduced sperm quality. Suggest why this may be so.

Answer*:* Tight-fitting underwear hugs the testes closer to the body, increasing the temperature for sperm production and maturation. This increase in temperature could decrease sperm production because the temperature exceeds the optimum for normal sperm production.

**b** If a man uses a laptop computer on his lap for long periods, is it possible that his sperm production could be affected? Explain why this can happen.

Answer*:* Yes, because the laptop would emit heat over his testes, thus increasing the temperature. This increase in temperature may exceed the optimum for sperm production and could decrease sperm production and/or viability.

**21** Some oral contraceptive pills contain oestrogen and progesterone. Suggest how they are able to prevent ovulation.

Answer*:* Higher levels of oestrogen and progesterone indicate that ovulation has just taken place and the corpus luteum is still present. The levels of oestrogen inhibit the secretion of FSH and the levels of progesterone inhibit the secretion of LH. No new follicles are matured for ovulation while those levels remain high.

Extend

**22** The head of the penis is covered in loose skin called the foreskin. Removal of the foreskin is an operation called circumcision. Circumcision was once a widespread practice in Australia but is now rarely performed. Find out:

**a** the advantages of circumcision

Answer*:* There is some evidence for a decreased risk of urinary tract infections and a reduced risk of sexually transmitted infections in men. Easier hygiene and a decreased risk of penile cancers are also advantages of circumcision.

**b** any disadvantages associated with circumcision and why most medical practitioners are now opposed to the practice

Answer*:* Disadvantages include pain, risk of bleeding and infection at the site of the circumcision, and irritation of the glans. There are few health benefits linked to circumcision and it may be seen as disfigurement.

**c** whether circumcision has links with specific cultures or particular religious beliefs.

Answer*:* Circumcision is more common in people of Jewish and Islamic faith. It is also prevalent in South Korea, the United States and Africa.

**23** Find out:

**a** the symptoms of endometriosis

Answer*:* Symptoms and severity vary between women, however some common symptoms include;

* Painful periods
* Pain in the lower abdomen before and during menstruation
* Heavy menstrual bleeding or bleeding between periods
* Infertility
* Pain following sexual intercourse

**b** possible causes of endometriosis

Answer*:* There may be many causes including:

* Retrograde menstruation, where menstrual fluid runs back up the fallopian tubes and into the pelvic cavity
* Genetic factors, endometriosis can run in families.
* Immune system problems that does not destroy errant endometrial cells.
* Hormones that transform the cells outside of the uterus into cells similar to those that make up the endometrium.

**c** how diagnosis is made

Answer*:* A pelvic examination where a doctor will manually feel for areas in the pelvis that are abnormal, ultrasounds either through the abdominal wall or transvaginal, looking for cysts that are associated with endometriosis, an MRI or a laparoscopy.

**d** the treatment.

Answer*:* Pain medication; hormone therapy to relieve the pain and stop the progression of the endometriosis; going on a hormonal contraceptive pill; Danazol – a medication taken to stop menstruation and reduce symptoms; surgery, ranging from a laparoscopy to remove endometrial tissue to a hysterectomy to remove the uterus, cervix and ovaries.

24 In the 1830s, the average age of a female’s first menstruation was 17. Now, in Australia, it is 12. A similar trend of decreasing age of puberty is evident in males. Find out:

**a** the reasons that researchers have suggested for the decreasing age of puberty in both females and males

Answer*:* One suggestion is the link to childhood obesity – fat cells produce oestrogen. Oestrogen is a contributor to the onset of puberty

Also, exposure to endocrine-disrupting chemicals, commonly found in cosmetic products and pesticides. These chemicals can mimic oestrogen in the body.

**b** the social problems that are arising through males and females reaching physical maturity at an earlier age.

Answer*:* The social problems can be varied, however some include:

* Mental health issues such as depressions or substance abuse
* Increase risk-taking behaviour including early initiation of sexual intercourse.