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Answers

Chapter 12 Reproduction produces offspring

Questions 12.1

Recall knowledge

**1** Define ‘male pronucleus’, ‘acrosome’, ‘zygote’, ‘sperm mortality’ and ‘ejaculation’.

Answer:

‘male pronucleus’: The haploid nucleus of the sperm

‘acrosome’: An organelle that develops at the head of the sperm, it contains enzymes needed for fertilisation.

‘zygote’: The fertilised egg from which a new individual develops.

‘sperm mortality’: The death rate of sperm

‘ejaculation’: The rhythmic contraction of the epididymis, vasa deferentia, seminal vesicles and the prostate gland to expel their contents into the urethra and then out of the body.

**2** Describe the process that causes a penile erection.

Answer: An erection results from blood rushing into the spaces of the erectile tissue of the penis as a result of sexual excitation.

**3** List the components of semen.

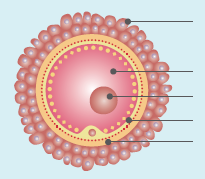
Answer: The liquid that carries and nourishes the sperm, also called seminal fluid. Contains the secretions of the seminal vesicles, prostate gland and the bulbo-urethral glands along with sperm.

**4** List the processes that cause the movement of sperm through the female reproductive tract.

Answer: The sperm swim through the cervix and the body of the uterus towards the uterine tubes.

The muscular contractions of the uterus and uterine tubes help transport the sperm as well.

**5** Label the plasma membrane, nucleus, cytoplasm, zona pellucida and corona radiata on the diagram below.



Answer*:* Correct labels, from top to bottom:

Corona radiata

Cytoplasm

Nucleus

Plasma membrane

Zona pellucida

**6** Describe the acrosomal reaction.

Answer: The acrosomal reaction is when the digestive enzymes, found within the acrosome, are released. These enzymes break down the glycoprotein matrix of the zona pellucida, giving sperm access to the plasma membrane of the oocyte.

Apply knowledge

**7** Explain why a large number of sperm are needed for the fertilisation of one ovum.

Answer: A large number of sperm are needed to provide sufficient enzyme required to break down the follicle cells in the corona radiata surrounding the oocyte. The internal environment of the uterus is acidic, and is hostile towards the sperm, killing many of them. Sperm mortality is high. Large numbers are also required to increase the chance of fertilisation.

**8** Use a flow diagram to demonstrate the processes from sexual intercourse to fertilisation.

Answer:

Questions 12.2

Recall knowledge

**1** Define ‘zygote’, ‘stem cell’, ‘pluripotent’ and ‘primary germ layer’.

Answer:

zygote: A fertilised egg from which a new individual develops.

stem cell: Cells that have the ability to produce different types of body cells.

pluripotent: Stem cells that are able to give rise to many, but not all, cell types necessary for foetal development.

primary germ layer: The embryonic tissues from which all tissues and organs of the body will develop; the ectoderm, endoderm and mesoderm.

**2** Draw a labelled diagram of a blastocyst.

Answer*:* Refer to Figure 12.5 on page 307 of the student book.

**3** List the key features of stem cells.

Answer:

* They are not specialised for any particular role.
* They are capable of repeated mitotic division or proliferation.
* They are able to differentiate into specialised cells.

**4** The cells produced by the initial cell divisions are totipotent. Suggest why this is important.

Answer: Totipotent stem cells are able to differentiate into all the cell types needed for embryonic development, including the embryo itself and the membranes associated with embryonic development.

**5** Name the primary germ layer that produces:

**a** hair Answer*:* ectoderm

**b** the lining of the lungs Answer*:* endoderm

**c** bones Answer*:* mesoderm

**d** the brain Answer*:* ectoderm

**e** blood. Answer*:* mesoderm

**6** List the functions of the amniotic fluid.

Answer:

* Protects the embryo, acting as a shock absorber
* Helps maintain a constant temperature
* Allows free movement of the embryo and foetus.

**7** Describe how blood flows from the

**a** foetus to the placenta

Answer:

The blood is carried away from the foetus towards the placenta in the two umbilical arteries.

**b** placenta to the foetus

Answer: A single umbilical vein carries blood from the placenta towards the foetus.

**c** mother to the placenta

Answer: Blood from the mother enters the placenta through the uterine arteries.

**d** placenta to the mother.

Answer: Blood leaves the placenta through the uterine veins.

Apply knowledge

**8** Women who are trying to get pregnant may be prescribed progesterone to take after ovulation. Explain why this may increase the chances of pregnancy.

Answer: Progesterone is the hormone that prepares the uterine lining for successful implantation of a fertilised egg. By increasing progesterone levels, there should be an increase in the development of the uterine wall so if fertilisation occurs, implantation is more successful.

**9** Prenatal check-ups monitor the health of the placenta. Suggest why this is important.

Answer: The placenta is responsible for supplying nutrients to, and taking wastes away from, the foetus. It also acts as an endocrine gland, secreting many hormones needed to maintain pregnancy. Placental health is vital if a pregnancy is to be successful.

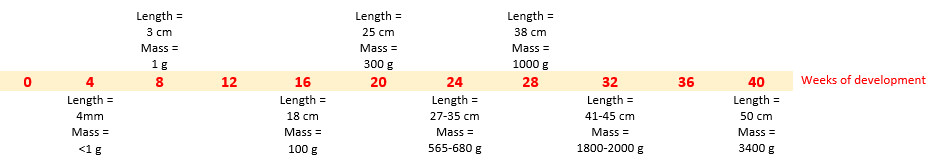
**10** Use the position of the primary germ layers to justify the structures that they eventually form.

Answer: The ectoderm is the outmost germ layer and it forms the outer layers of the body. The mesoderm is the middle layer and it forms the ‘middle’ components of the human body – such as the connective tissues, stomach, intestines and the muscles. The endoderm is the innermost layer and forms the inner lining of the digestive system and respiratory system.

Questions 12.3

Recall knowledge

**1** Construct a timeline showing the length and mass of the embryo from 4 weeks until 40 weeks.

Answer:

**2** At what age does an embryo become a foetus?

Answer: Embryonic development ends at the end of the 8th week.

**3** State the age when each of the following occurs:

**a** eyes form as slits Answer*:* 8 weeks

**b** kicking and turning can be felt clearly Answer*:* 20 weeks

**c** the testes descend into the scrotum Answer*:* 28 weeks

**d** fingerprints appear Answer*:* 16 weeks

**e** the brain begins to develop Answer*:* 4 weeks

**f** arm buds form Answer*:* 5th week

**g** the brain is well developed and has furrows. Answer*:* 28 weeks

**4** List the reasons for increased urination during pregnancy.

Answer: The mother has a greater blood volume to cater for the blood flowing through the placenta. This results in increased blood flow to the kidneys and greater urine production. The expanding uterus also puts pressure on the urine, making it feel as though it is full of fluid.

Apply knowledge

**5** Explain the difference between pregnancy and gestation.

Answer*:* Gestation is the period of time between conception and birth. Pregnancy is the series of changes that takes place in a woman’s body and tissues as a result of the developing foetus. During a pregnancy there may be multiple gestations, in the case of twins for example.

**6** Babies born prematurely often need to be put on a respirator to breathe for them. Suggest the reason for this.

Answer*:* The lungs are among the last organs to fully develop in the mother’s uterus. Lungs start to develop at the 26th week of pregnancy; by week 36 the foetus’ lungs are fully formed. Premature babies’ lungs are not mature enough to be able to take in air, so a ventilator is used to keep the lungs inflated for gas exchange to occur.

**7** Explain why heavily pregnant women eat smaller meals than normal.

Answer: The stomach is pushed upwards and outwards in the abdominal cavity, making its capacity smaller. Heavily pregnant women will eat smaller meals and still feel full, as the stomach is unable to hold the normal amount of food.

Questions 12.4

Recall knowledge

**1** What term is used to describe the birth of a baby?

Answer*:* Parturition.

**2** Use a flow chart to summarise the birth process.

Answer: The foetus has settled head down into the mothers pelvis → Regular contractions of increasing strength occur → the cervix dilates to around 10 cm and the uterus, cervix and vagina forms the birth canal → waters break (amniotic sac bursts) and expulsion of the foetus occurs → Final stage of the birth process is the delivery of the afterbirth (placenta, amnion and chorion)

**3** State the average length of the first stage of labour for a woman having her:

**a** second child

Answer*:* Four hours

**b** first child

Answer*:* Eight to nine hours

**c** fourth child.

Answer*:* Four hours

**4** Describe the birth canal.

Answer*:* The birth canal is a single curved passaged formed from the uterus, cervix and vagina

Apply knowledge

**5** Explain the advantage of having a foramen ovale.

Answer: The blood entering the right atrium can move quickly through the foramen ovale into the left atrium. This is beneficial so the oxygenated blood from the placenta can quickly be delivered to the tissues of the foetus.

**6** Describe the changes that cause the closure of the ductus arteriosus following birth.

Answer: The lungs inflate at birth and no longer provide resistance to blood flow. Therefore, blood flow through the ductus arteriosus reduces. It is also important that the blood vessel closes so that blood goes to the lungs to oxygenate as the placenta is no longer functional.

**7** Explain the importance of the position of the foetus just before birth.

Answer: The foetus moves head down into the pelvis, usually facing the mothers hip bone, knees drawn up to its abdomen with its legs crossed. As such the foetus is taking up the least available space. The head also acts as a ‘battering ram’ to push against the cervix and stretch the vagina.

**8** On TV, it is common for a woman giving birth to say that they ‘have to push’. Discuss whether this is a realistic statement.

Answer: As the foetus moves through the birth canal, the head stretches the vagina. This distension stimulates the woman to contract her abdominal muscles. This is a conscious movement and works with the involuntary contractions of the uterus. The comment ‘have to push’ is realistic as contraction of the abdominal muscles is under conscious control.

**9** The ductus venosus could be compared to a bypass highway: a road that goes around busy areas of traffic. Discuss whether or not this analogy is accurate.

Answer: The ductus venosus allows blood to bypass the liver, in the foetus this causes no problems as the mother’s liver is serving the needs of the developing foetus. In the provided analogy, the bypass avoids congestion, this would not be accurate in the foetus as the liver is not fully functional and therefore would not be ‘busy’.

Questions 12.5

Recall knowledge

**1** Define ‘teratogen’ and ‘foetal alcohol syndrome’.

Answer*:* A teratogen is an agent that causes physical defects in a developing foetus; it can also be called a teratogenic agent.

Foetal alcohol syndrome is a term used to describe the effects of foetal exposure to alcohol. Newborns with foetal alcohol syndrome frequently show lower than normal birthweight, a small head and slow growth.

**2** By what percentage does the mother’s blood volume increase during pregnancy?

Answer*:* The mother’s blood volume will increase by 40%.

**3** List three nutrients that pregnant women require in a higher level than non-pregnant women.

Answer*:* Examples include protein, folic acid/folate, calcium, fluoride, vitamin A

**4** Explain why females who are trying to get pregnant should take folic acid supplements.

Answer*:* Folic acid is essential for normal cell division and the manufacture of proteins. A lack of folate before and during pregnancy can contribute to spina bifida and other neural tube defects.

**5** State five lifestyle choices that pregnant women should make.

Answer:

* Maintain a healthy and balanced diet, avoiding food that have a risk of listeria infection.
* Don’t drink alcohol
* Exercise regularly
* Don’t smoke tobacco
* Avoid drugs including LSD, marijuana, antibiotics, anticoagulants, thyroid drugs etc.

**6** List the reasons that women gain weight during pregnancy.

Answer:

* Weight gain can be attributed to the weight of the foetus, the placenta and the amniotic fluid.
* Increased blood volume and the increased size of breasts and uterus.
* Hormonal changes promote the conversion of energy to fat and water retention in the body can also contribute.

**7** State the most common consequence of drinking alcohol during pregnancy.

Answer: Foetal alcohol syndrome is the most common consequence of drinking alcohol during pregnancy.

**8** Describe the effects of thalidomide on the embryo.

Answer: Thalidomide was prescribed to help in the prevention of morning sickness symptoms. It results in significant malformations of limbs as it acts on the embryo between the 28th and 42nd days of development. During that time frame, the limbs are staring to appear as microscopic buds before developing into recognisable limbs by the 42nd day. Arms are the first to develop, which accounts for why thalidomide affects the arms more frequently than the legs.

Apply knowledge

**9** Explain why pregnant women are likely to experience constipation, especially late in the pregnancy.

Answer: Constipation is more common due to the slowing down of body functions in the mother. The slower activity of the alimentary canal and the reduced rate of movement of food along the large intestine can result in constipation.

**10** During pregnancy, a woman’s resting heart rate may rise to 90 beats per minute. Explain why this is higher than a non-pregnant woman’s heart rate.

Answer: Pregnant women have a higher blood volume, to meet the needs of the placenta and the developing foetus. This results in faster rates of circulation through her blood vessels and an increase in resting heart rate.

**11** Explain why pregnant women should not eat soft cheeses such as camembert.

Answer: Soft cheeses, such as camembert, can contain listeria bacteria that can cause an infection called listeriosis. Listeriosis infection in pregnant women can cause miscarriage, stillbirth, uterine infections and preterm delivery.

Chapter 12 activities

Activity 12.2 Investigating pregnancy and exercise

What to do

**1** Identify the dependent and independent variables in this investigation.

Answer*:* Dependent variable: full-term delivery, or avoidance of premature delivery

Independent variable: Exercise during pregnancy

**2** Propose a hypothesis that states a relationship between the two variables.

Answer*:* Potential hypotheses include:

* Women who exercise during pregnancy have fewer premature deliveries.
* Women who do not exercise during pregnancy have more premature deliveries.
* Exercise during pregnancy has no effect on time of delivery.

**3** Use Google Forms, SurveyMonkey, Microsoft Forms or a similar program to create a survey that could be given to mothers after the birth of their babies. The questions should be designed so that the answers will either support or disprove your hypothesis.

Answer*:* Student questionnaires will vary, but check that questions are concise and clear, and that they will elicit a definitive answer.

Studying your observations

**1** What pattern of answers to your questions would support your hypothesis?

Answer*:* Student responses will depend on whether the hypothesis has been worded in a manner supporting exercise for a full-term pregnancy, or in a way suggesting lack of exercise contributes to premature birth.

**2** How would you go about conducting your survey? In particular, how would you select participants?

Answer*:* Participants should be selected from as wide a cross-section of society as possible. Students may suggest selecting participants from a particular age group in order to control the age variable. In that case, the hypothesis would have to refer to the age group selected (for example, ‘that women aged 25–30 who exercise during pregnancy will have fewer premature births’).

**3** How many participants would be necessary to enable you to decide whether your hypothesis was supported or disproved?

Answer*:* Teachers should check that students suggest a manageable number, but one that would still support or disprove the hypothesis.

Chapter 12 review questions

Recall

**1 a** Define ‘fertilisation’.

Answer*:* Fertilisation is the fusion of a sperm and an egg (ovum).

**b** Describe the events that take place in humans so that fertilisation can be achieved.

Answer*:* Fertilisation is achieved via sexual intercourse.

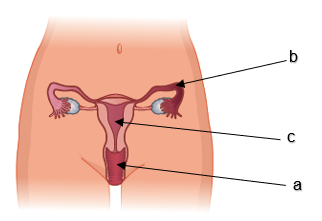
* The penis must become engorged with blood to result in an erection.
* The vagina is stimulated and secretes mucus from glands around the cervix. This allows easy entry of the penis.
* When the erect penis becomes stimulated within the vagina, ejaculation occurs via rhythmic contractions of the epididymis, the vas deferens, the seminal vesicles and the prostate gland.
* Sperm are deposited, via the penis, into the vagina. Sperm swim in the semen through the cervix, into the uterus, then through the uterus and into the uterine tube.

**c** Name the structure where fertilisation normally occurs.

Answer*:* Fertilisation usually occurs in the upper third of a uterine tube.

**d** What is a zygote?

Answer*:* A zygote is formed when fertilisation is complete, resulting in a fertilised egg; it is the first cell of the new individual.

**2** On the diagram below, clearly identify where:

**a** sperm are deposited

Answer:

**b** fertilisation takes place

**c** implantation occurs.

**3** Describe the process of implantation.

Answer*:* Implantation is the process where the blastocyst embeds in, and attaches to, the endometrium of the uterus.

Implantation occurs in the uterus by the blastocyst sinking into the soft endometrium then attaching to the wall. This occurs 6–12 days after ovulation with an average of approximately 9 days.

**4 a** Draw a labelled diagram of a blastocyst.

Answer*:* Refer to Figure 12.5 on page 307 of the student book.

**b** At what stage of embryonic development does a blastocyst occur?

Answer*:* The blastocyst occurs at about five days after fertilisation when the dividing cells have reached the uterus.

**c** What type of stem cells exist in the blastocyst?

Answer*:* Pluripotent stem cells are found in the inner cell mass.

**5 a** Name the three embryonic germ layers.

Answer*:* Endoderm, mesoderm, ectoderm

**b** Give two examples of tissues that develop from each of the germ layers.

Answer:

|  |  |
| --- | --- |
| **Germ layer** | **Examples of tissues that develop (any two of each)** |
| Endoderm | Epithelium of  • the alimentary canal  • respiratory system  • urinary bladder  • urethra  • gall bladder  • tonsils  • thyroid  • thymus  • vagina |
| Mesoderm | • Skeletal, smooth and cardiac muscles  • Cartilage, bone, blood and connective tissues  • Endothelium of the blood vessels and lymphatics  • Epithelium of:  - the body cavities and joint cavities  - kidneys  - ureters  - ovaries  - testes  - adrenal cortex  • Dermis of the skin |
| Ectoderm | • Epidermis of the skin  • Hair  • Nails  • Glands of the skin  • Receptor cells of the sense organs  • Epithelium of the mouth, nostrils, sinuses and glands of the mouth  • Epithelium of anal canal  • Enamel of the teeth  • The entire nervous system  • The anterior lobe of the pituitary and the adrenal medulla  • Lens, cornea and muscles of eye |

**6** Describe the placenta, including the embryonic tissues it develops from and the functions it performs.

Answer*:* The placenta is the organ that supplies nutrients to and removes wastes from the foetus. It is created from a combination of maternal and foetal tissues. It also produces hormones to maintain pregnancy and is attached to the foetus via the umbilical cord. The placenta is fully developed by the end of the third month of pregnancy. In the placenta the mother’s blood is very close to the blood capillaries of the foetus and this allows for the ready diffusion of materials between the two circulations.

The placenta develops from part of the chorion, which is one of the embryonic membranes.

The placenta supplies nutrients and oxygen to and removes wastes (including carbon dioxide) from the foetus. It also produces hormones to maintain pregnancy. It allows for the transfer of antibodies from mother to foetus.

**7** Describe the main features of the eight-week-old embryo.

Answer*:* At 8 weeks, the embryo has a recognisably human form. All organs are present, but not all are functioning. It is now 3 cm long and weighs 1 g. It has an enlarged head (about half the size of the embryo), slit-like eyes, a nose, small earlobes and a jaw that is almost fully formed. There are arms, legs, hands, fingers and toes. The external sex organs are present so that sex can be determined.

**8** Draw a diagram to show how blood from the embryo/foetus gets to and from the placenta.

Answer*:* Student should draw a simplified diagram of Figure 12.12 on page 312 of the student book, with the embryo/foetus, umbilical cord, umbilical arteries, umbilical vein, placenta, chorionic villi and endometrium labelled. Diagram should show that two umbilical arteries carry blood from the placenta to the foetus, and one umbilical vein carries blood from the foetus towards the placenta.

**9** List the changes that occur in the mother during pregnancy.

Answer:

* Abdomen bulges
* Uterine growth
* Stomach, intestines and liver are pushed upward
* Breasts enlarge
* Milk-secreting tissue develops in the breasts
* Heart size increases
* Blood volume increases
* Blood flow to the kidneys increases
* Urine production increases
* Increased pressure on the bladder and more frequent urination
* Changes in mood
* Change in hormone levels

**10 a** Make a list of factors that a pregnant woman should consider in regards to her diet.

Answer:

* Increased energy intake (850 kJ daily)
* Increased protein intake (≥65 g daily)
* Increased intake of calcium, iron and folic acid
* Cease alcohol intake
* Cease intake of recreational drugs
* Decreased or no medicinal drug intake (depends on drug)
* If a smoker, stop smoking

**b** Women gain weight during pregnancy. In addition to the growing foetus, what else contributes to the weight gain?

Answer*:* The placenta, amniotic fluid, increased blood volume, size of the breasts and the uterus, and retention of water contribute to the weight gain of the mother, in addition to the growing foetus.

**11** List the benefits of exercise for a pregnant woman.

Answer*:* It is beneficial for a pregnant woman to exercise because:

* she is more likely to carry the pregnancy until full term
* it will help her to maintain stamina during labour
* she will regain her pre-pregnancy physical fitness more quickly.

**12 a** Define the term ‘teratogen’ (or ‘teratogenic agent’).

Answer*:* Teratogens are agents that may cause physical defects to a developing embryo.

**b** List examples of teratogenic agents.

Answer:

• Some hormones • Antibiotics

• Oral anticoagulants • Anticonvulsants

• Anti-tumour drugs • Thyroid drugs

• Thalidomide • LSD

• Marijuana • Many other drugs

• X-rays and other radiation • Certain viruses

**13** Distinguish between gestation and parturition.

Answer*:* Gestation is the length of time that the foetus and embryo are in the uterus. Parturition is the process of birth during which the foetus is expelled from the mother’s body.

**14** Briefly describe the events that take place during the:

**a** first stage of labour

Answer*:* The first stage of labour involves the dilation of the cervix – the time from the onset of labour to the cervix being fully dilated. It is usually 8–9 hours in length for a first labour, and 4 hours for all following labours. It involves waves of contraction from the upper to lower part of the uterus. With each contraction there is a pulling action on the cervix, dilating it to 10 cm. These contractions also force the head of the foetus to push into the cervix, assisting dilation.

**b** second stage of labour

Answer*:* The second stage of labour results in the expulsion of the foetus. This stage usually takes from 20 minutes to two hours, and usually commences with the rupturing of the membranes (the waters breaking) and concludes when the baby is born. (The membranes may break during the first stage.)

The foetus moves through the cervix into the vagina and the vagina is stretched. The stretching of the vagina stimulates the uterus to continue contracting and the woman to contract her abdominal muscles, pushing the foetus further into the vagina. The baby’s head will turn so that the face is downwards.

During this stage, the woman’s pulse rate increases and she begins to sweat. The baby’s head emerges and, as it does so, turns to face the woman’s hips. This rotation allows the shoulders to move through the birth canal.

The baby now moves readily through the birth canal until it is completely expelled from the woman’s body.

**c** third stage of labour.

Answer*:* The uterus continues to contract and the placenta, membranes and umbilical cord are expelled approximately five minutes after the completion of the second stage of labour. The placental blood vessels constrict to reduce blood loss, while contractions of the uterus squeeze shut the uterine vessels that supplied blood to the placenta.

**15** Briefly describe the stimuli that normally trigger the newborn’s first breath.

Answer*:* The baby’s first breath is normally triggered by the shock of birth. This stimulates the respiratory centre of the brain and results in the lungs beginning to function. The rise of carbon dioxide in the baby’s blood also stimulates this process. (The baby’s carbon dioxide levels rise because it is no longer connected to the placenta via the umbilical cord.)

Explain

**16 a** Explain the need for the production of very large numbers of sperm in order for fertilisation to take place.

Answer*:* The large number of sperm is necessary because there is a high sperm mortality rate in the vagina and uterus. In addition, the amount of enzyme in the head of one sperm cannot by itself break down the acid holding the cells of the corona radiata around the ovum. The enzyme from many thousands of sperm is required.

**b** Besides sperm, what other components make up the semen?

Answer*:* Semen is composed of sperm and secretions from the seminal vesicles (a nourishing thick fluid), secretions from the bulbo-urethral glands, the prostate gland and enzymes that activate the sperm once ejaculation has occurred.

**17** Distinguish between proliferation and differentiation.

Answer*:* Proliferation is when cells make new cells.

Differentiation is when cells develop into different types of cells; that is, when *unspecialised* cells develop into *specialised* cells.

**18** Compare and contrast an embryo and a foetus.

Answer*:* An embryo is the term given to the new individual in the uterus for the first two months of pregnancy. From two months on, until birth, the developing individual is referred to as a foetus.

**19** Explain how amniotic fluid helps the development of the foetus.

Answer*:* The amniotic fluid aids foetal development by helping prevent injury, allowing the growing and developing limbs to move, supporting the tissues as they grow and develop, and maintaining a stable environment.

**20** To meet the requirements of the developing foetus, a large quantity of blood needs to flow through the placenta. Describe the changes in the mother’s body that make it possible for a lot of blood to flow through the placenta.

Answer*:* The changes in the mother’s body that make it possible for a lot of blood to flow through the placenta include:

* a gradual increase in blood volume – up to a 40% increase by the end of pregnancy
* faster rate of circulation achieved by:

- increased heart rate

- increased amount of blood pumped by each heartbeat.

**21** Describe the changes that take place in the baby’s circulatory system at birth. In doing so, ensure that you explain clearly the role of the ductus arteriosus, foramen ovale, ductus venosus and umbilical blood vessels in the foetal circulation.

Answer*:* The baby was not able to use its lungs while in the uterus, so the blood bypassed the lungs via the ductus arteriosus. At birth the lungs are required, and blood increasingly flows through them. Thus, the ductus arteriosus is no longer required, and a few weeks after birth it becomes fibrous tissue.

The foramen ovale was open during uterine development to allow highly oxygenated blood in the right atrium to flow into the left atrium and then be rapidly pumped to the foetal tissues. After birth, the increasing amount of blood entering the left atrium of the heart from the now functioning lungs has enough pressure to force the flap of the foramen ovale against the atrial wall, thus closing it.

Before birth, the mother’s liver functioned for both herself and the foetus. At birth that can no longer happen. The ductus venosus that allowed the blood to bypass the liver of the foetus no longer receives blood flow because it was fed from the umbilical blood vessels in the umbilical cord, which is now cut.

The ductus venosus gradually constricts and closes off.

Apply

**22** Can a woman become pregnant the first time she has sexual intercourse? Explain.

Answer*:* Yes, if she has ovulated and fertilisation takes place.

**23** Explain how the human male and female reproductive organs are arranged so that sperm can be transferred from the body of the male to the female for fertilisation to occur.

Answer*:* The transfer is possible because the erect penis is inserted into the vagina. The ejaculation of sperm is an upward motion and the sperm swim up the cervix and uterus into the uterine tubes. Once ovulation has occurred, the egg moves down the uterine tube towards the sperm. The male has glands that produce semen, in which sperm can swim through the reproductive tract of the female.

**24** Why should a pregnant woman read the labels of prepared foods and medicinal products?

Answer*:* Pregnant women should check food and medicine labels to see if there are any warnings about their use during pregnancy.

**25** Explain why menstruation does not take place during pregnancy.

Answer*:* During pregnancy, menstruation does not occur because the corpus luteum is maintained by the secretion of chorionic gonadotrophin from the developing placenta. The corpus luteum secretes progesterone to maintain the endometrium and as levels of progesterone increase in the blood, the production of luteinising hormone decreases. Once the placenta can produce the hormones to maintain the endometrium and pregnancy, the corpus luteum can begin its slow degradation. Menstruation does not take place while the endometrium is being maintained.

**26** What changes take place in the uterus, cervix and vagina to allow them to function as a ‘birth canal’?

Answer*:* As the uterus begins to contract and expel the foetus, the cervix dilates and the vagina stretches, forming a passage that functions as the birth canal.

Extend

**27** Animals that breed in water, such as crayfish, fish and frogs, have no penis or vagina. Explain the advantages of these organs for a mammal, such as a human.

Answer*:* Having a penis and vagina means that there can be internal fertilisation and sperm transfer does not have to take place in water. Sperm are transferred directly from the male to the female with no chance of drying out or being washed away by water currents. This allows a smaller number of gametes to be produced. Internal fertilisation increases the chance of a sperm and egg fusing to produce a zygote.

**28** Explain how a blastocyst can consist of many more cells than a zygote, yet be only slightly larger in size.

Answer*:* The cells in a blastocyst are thinner and smaller than those of a zygote. The two original cells that form a zygote are a sperm and an egg. These then divide multiple times to form a blastocyst, so the blastocyst’s cells are smaller and in thin layers. The cells that make up the blastocyst divide many times without increasing in size between divisions.

**29** Since the introduction of vaccination for rubella, the incidence of the disease has dropped, significantly reducing birth defects due to this disease. Find out what other vaccination programs could help reduce harm to the developing foetus.

Answer*:* Individual research so answers will vary. Students may come up with a list of the following diseases, for which vaccination programs significantly reduce the risk of foetal harm.

* Chickenpox can cause defects to the baby’s brain, eyes, skin and limbs.
* Measles increases the risk of miscarriage, premature birth and stillbirth.
* Mumps increases the risk of a miscarriage.
* Hepatitis B can result in the foetus becoming infected or becoming a carrier of the disease.
* Influenza increases the risk of miscarriage, premature birth and stillbirth.

In addition, a vaccine containing induced antibodies that facilitate the cessation of smoking by blocking nicotine penetration into the brain also reduces the drug’s passage across the placenta. This finding suggests that maternal immunisation during pregnancy may be safe and may to some extent protect the foetus from exposure to nicotine.

**30** Describe the survival advantage of having the umbilical vessels constricting before they are cut.

Answer*:* If the umbilical vessels constrict before the umbilical cord is cut, it allows a rise in carbon dioxide levels in the baby’s blood. This stimulates the respiratory centre of the brain and results in the lungs beginning to function. This is a survival advantage because it triggers the baby’s first breath.

Constriction of the umbilical blood vessels also minimises blood loss when the cord is cut, and this would also act as a survival advantage for both the mother and newborn.

**31** Australian doctors, in general, prefer women to have their babies in a hospital. Discuss the advantages and disadvantages of this approach compared with a homebirth.

Answer:

|  |  |  |
| --- | --- | --- |
|  | **Advantages** | **Disadvantages** |
| Homebirths | • Privacy  • Comfort of familiar surroundings  • Personal control  • No unnecessary medical interventions  • Risk of infection is reduced for both the mother and baby  • Have anyone the mother desires present  • Choice of birthing positions  • Drug free  • Mother and baby and family bonding | • The mother does not have access to expert support and  must take greater responsibility for decisions that may impact on her health or the baby’s health  • Social impact of choosing homebirth as hospital birth is the currently accepted model  • Medical intervention in case of a problem in delivery is not  at hand  • Personal arrangements must be made for postpartum care  • The cost of homebirth may not be covered by private  medical insurance |
| Hospital births | • Safe environment if the mother or child is at risk of medical complications  • Safe if there are unexpected medical complications during the birth  • Immediate paediatric attention is available if the baby needs medical care  • 24-hour care for mother and child is available | • Lack of parental control over the process  • Hospitals can seem more impersonal  • Sometimes there is routine separation of the mother and baby  • The birth is usually managed by the nurses and doctors, not the mother  • A greater risk of infections  • Less privacy  • Bound by hospital protocols and procedures  • Sometimes no choice in labour position |

**32** If the foramen ovale fails to close, a baby may be born with a ‘hole in the heart’. Use references to determine how often this birth defect occurs. What reasons are suggested for the failure of the foramen ovale to close? How soon after birth do doctors operate to rectify this situation?

Answer*:* More than 2200 babies with a heart defect are born in Australia each year, including babies born with a hole in the heart.

In 2007 scientists from the Garvan Institute and Victor Chang Cardiac Research Institute in Sydney found a genetic mutation that could explain why some babies are born with a hole in the heart.

Up to 20% of heart defects are gene-linked abnormalities; however, for the other 80% or so, the cause is unknown.

Sometimes doctors need to operate on a child urgently to rectify a heart defect in the first few weeks after birth. If there is no urgency, the operation may take place in the first one to two years of life, unless the problem is detected later or does not merit an operation until an older age. Continual monitoring of the heart defect would take place and if any change were detected, appropriate medical intervention would take place.

**33** A newborn infant has a rapid breathing rate and heart rate. Find out why these rates are high and for how long they stay high. What is the survival advantage for the infant?

Answer*:* A newborn infant’s breathing rate: 30–60 breaths per minute

A newborn infant’s heart rate: 120–150 beats per minute

These accelerated rates usually last for up to six months, although they may begin to diminish well before that time. This is a survival advantage because the baby is born naked and the accelerated rates supply more oxygen to the muscles, which are working to keep the baby warm.

It has also been suggested that a baby’s heart rate is higher than an adult’s because the blood does not have as far to travel around the body/lungs before returning to the heart again.

**34** One way of checking a male’s fertility is to do a sperm count. Conduct research to find out:

**a** what ‘sperm count’ means and what is considered a normal sperm count

Answer: A sperm count is determined by examining semen under a microscope to see how many sperm appear within squares on a grid pattern, this can be done by a person or by a computer. A normal sperm count ranges from 15 million sperm to more than 200 million sperm per millilitre of semen. Anything less than 15 million sperm/mL of semen is considered low.

**b** whether there is anything a male can do to increase his sperm count

Answer: To increase sperm count, it is recommended to maintain a healthy weight, exercise regularly, avoid substance abuse including heavy drinking, smoking tobacco or use of illegal drugs and anabolic steroids. Limit exposure to environmental pollutants including pesticides, solvents, heavy metals etc. Wear loose cotton boxers or briefs to keep the sperm development at the optimum temperature.

**c** whether it is possible for a male with a low sperm count to father children.

Answer: It is possible for a man with a low sperm count to father children, but it is more difficult and may require artificial reproductive techniques including intracytoplasmic sperm injection (ISCI) or gamete intra-fallopian transfer (GIFT) to increase the likelihood of fertilisation.

**35** In some pregnancies, and for a variety of reasons, the doctor looking after the woman may decide to induce labour. Reasons for this may include high blood pressure, bleeding, incompatibility of blood groups between foetus and mother, or a pregnancy that has gone on for more than 42 weeks. However, for most women, labour starts naturally.

**a** Find out about the initiation of labour under natural circumstances.

Answer: Natural initiation of labour is a result of changes in hormone levels in the woman. During the final stages of pregnancy, the uterus is stretched and causes the release of the stress hormone, cortisol. The rise in stress hormones causes the release of a steroid hormone called estriol (a form of oestrogen). Estriol inhibits the synthesis of progesterone and prepares the smooth muscle of the uterus for labour. As the uterus starts to contract (due to the higher levels of oestrogens and lower levels of progesterone), the uterus secretes prostaglandins and the ovaries secretes relaxin. Prostaglandins initiate labour and relaxin relaxes the muscles of the cervix and the muscles of the pelvis. Oxytocin is then released for continuation of labour.

**b** Does medical intervention to induce labour mimic the natural process? Describe the similarities and differences.

Answer: Medical intervention is similar to natural process in that hormones are also used to stimulate contractions of the uterus. The hormones are prostaglandins and oxytocin, the same in natural onset of labour.

Differences: Hormones are injected or slowly released through the use of a gel or pessary inserted into the vagina. These act to soften the cervix. Mechanical opening of the cervix or a membrane sweep to cause the release of prostaglandins. If cervical dilation has occurred a mechanical break of the amniotic sac can also be completed to induce labour. Injections of oxytocin will then be administered to assist the contractions of the uterus.

**c** How long do such induction techniques take to be effective?

Answer: The use of a gel or pessary to soften the cervix can take from 6 to 24 hours to have an effect. The other techniques can take up to 48 hours to induce labour.

**36** There is some concern in society regarding stem cells. Conduct research into the source of stem cells and their uses. Use this to discuss the reasons for people’s concerns and whether they are valid.

Answer: Stem cells sources are either adult stem cells or embryonic stem cells.

Adult stem cells can be taken from fully developed tissues including bone marrow, umbilical cord blood or adipose tissue. These cells are multipotent or some can be pluripotent.

Embryonic stem cells are taken from unused embryos resulting from in-vitro fertilisation (IVF) or can be collected from amniotic fluid. They are pluripotent.

Stem cells are used to replace cells damaged by chemotherapy, to repair or replace damaged tissues like cartilage. They could be used to grow new cells in a laboratory to replace damaged organs or tissues, for example replacement pancreatic beta cells to produce insulin. They could be used to screen for effect of new drugs. There is research and trials being conducted into therapeutic stem cells for treatment of Alzheimer’s and Parkinson’s disease.

The key ethical issues concern the destruction of human embryos for embryonic stem cell derivation, on the grounds that the human embryo is a human life. There are procedures established that prevent destruction of an embryo after 14 days, as at that point the cells have been programmed into the early stages of nervous system development. There are few ethical concerns over the use of adult stem cells.

It is challenging to state whether people’s concerns are valid or not. The dilemma comes from destroying potential human life to provide treatment for debilitating human diseases. Supporters of embryonic stem cell research generally feel that as the blastula would be destroyed anyway, it is reasonable to access these stem cells to use for research and developing medical technologies.