

## Chapter 15: Review Answers

Student Textbook pages 536-537

### Answers to Understanding Concepts Questions

1. Growth and differentiation are both forms of development. Differentiation refers to cellular development that forms a multitude of cells that have specialized functions (i.e., can become different structures and organs). This process only happens in embryos. Growth refers to established cells, structures, and organs increasing in size and maturing. This process relates to fetal development.
2. The egg and a quantity of sperm meet in an oviduct; the heads of the sperm bind to the outer covering of the egg and the enzymes in the acrosome begin to digest a path through the protective layer. Sperm use their tails to progress through the coating, with one sperm breaking through to enter the egg. Once breached, the membrane reseals itself to prevent any more sperm from binding to the egg. Within approximately 12 hours of successful penetration, the membranes of the sperm nucleus and the egg nucleus disappear and the 23 chromosomes found in each gamete create 23 pairs of chromosomes in the zygote.
3. A morula is a solid ball of 16 undifferentiated cells derived by cleavage. The blastocyst is a hollow structure containing differentiated cells.
4. (a) The inner cell mass, also known as the embryoblast, is the group of cells that will develop into the embryo.  
(b) The inner cell mass and the trophoblast contain two different types of cells. The trophoblast will develop

into the extra-embryonic membrane that will nourish the embryo.

5. hCG is a hormone that is released by the trophoblast. It has the same effect as LH (luteinizing hormone) and maintains the corpus luteum. This ensures that the hormones estrogen and progesterone will continue to be secreted and menstruation does not occur.
6. The embryonic disk is the structure that develops into the primary germ layers.
7. (a) *Ectoderm*: outer skin, hair, nails, sweat glands, mammary glands, nervous tissue and sense organs, pituitary gland, tooth enamel, eye lens, and adrenal medulla  
(b) *Endoderm*: cellular lining of the respiratory tract, digestive tract, urinary bladder, urethra; most of the liver; gall bladder; pancreas; thymus; part of the tonsils; parathyroid gland; thyroid gland  
(c) *Mesoderm*: dermis of skin; cellular lining of blood vessels, lymphatic vessels, body cavities; muscle tissue; connective tissue, including bone, cartilage, and blood; adrenal cortex; heart; kidneys and ureters; internal reproductive organs; spleen
8. The placenta is formed from both maternal and embryonic tissue. The embryo contribution comes from the extra-embryonic membrane called the chorion. At the end of the second week after fertilization, the chorionic villi (finger-like projections) establish the beginnings of the placenta in the endometrium. The blood pools of the mother are found in the placenta, and this is where the exchange of nutrients and waste occurs. The placenta is an organ rich in blood vessels through which metabolic exchange occurs. The placenta has five main functions: nutritional (transporting and storing nutrients), excretory (transporting wastes from fetus to mother), respiratory (transporting oxygen from mother to fetus), endocrine (estrogen, progesterone, and human chorionic gonadotropin), and immune (transporting antibodies from mother to fetus).
9. The chorion and amnion are both extra-embryonic membranes. The chorion is the outermost layer; it encloses all of the extra-embryonic membranes and also forms the fetal portion of the placenta. The amnion is a transparent sac developed from cells of the embryonic disc.
10. The amniotic fluid fills the amnion and protects and cushions the developing fetus, as well as preventing temperature fluctuations. The fluid also allows the freedom of movement and prevents the limbs from sticking to the body.
11. The yolk sac and the allantois in humans are both extra-embryonic membranes that assist in nourishing the embryo. In addition, both structures contribute to organ development. The yolk sac contributes to the formation of the digestive tract and produces the first blood cells

and future egg or sperm cells. The allantois is the foundation of the umbilical cord, with some of the structure becoming part of the urinary bladder.

12. Students' answers concerning the embryonic period should include any five of: cleavage; formation of the morula; differentiation of cells to form the blastocyst; implantation; secretion of hCG; formation of the embryonic disk; gastrulation (3 layers in the disk or primary germ layers); morphogenesis (differentiation into a number of different types of cells); neurulation; formation of separate organs; brain cells are differentiating; limbs are lengthening and flexing; nervous system is starting to coordinate activity; skeleton of cartilage forms; embryonic support structures are also developing (allantois, chorion, amnion, yolk sac, placenta, umbilical cord).

Students' answers concerning the fetal period should include any five of: organs maturing; fetus growing in size; cartilage in skeleton replaced by bone; reproductive organs mature and become visible; heartbeat becomes audible; lanugo develops to protect baby's skin; capillaries begin to extend into skin; layer of fat develops beneath skin; digestive and respiratory systems mature.

13. Morphogenesis refers to the process of forming distinct structures.
14. (a) Progesterone and estrogen levels drop. Prostaglandins and oxytocin levels then rise. Prostaglandins and oxytocin cause the uterus to contract, beginning labour.  
(b) The contractions cause the cervix to dilate; at some point, the amnion breaks and the amniotic fluid is released. Forceful contractions move the fetus through the cervix to the birth canal and the fetus is expelled. Once the baby is delivered and breathing normally, the umbilical cord is clamped, cut, and tied. The placenta is then normally delivered in a short time period after the delivery of the child.
15. The fetal and maternal blood vessels are close together in the placenta to allow materials within the maternal circulatory system to diffuse across to the fetus. If chemical teratogens are in the mother's blood stream, they will also diffuse across the placenta into the fetal bloodstream.
16. *Beneficial health habits* include: supplementing folic acid (helps to avoid neural tube defects); ensuring sufficient rest (so the body has the resources to support the pregnancy); ensuring adequate nutrition (so the body has the resources to support the pregnancy); protecting against STDs (which can be passed on to the baby); staying away from second-hand smoke (which can harm fetal development); avoiding x-rays, pollutants and known environmental carcinogens wherever possible (can cause congenital structural defects).

*Detrimental health habits* include: consumption of alcohol (can damage the brain of the developing embryo and

fetus; cause low birth weight, height and head size; affect learning and memory (FASD)); smoking (increases risk of low birth weight, premature births, still births, miscarriages, behavioural problems, reduced intellectual ability); overdosing on vitamin C (causes scurvy).

17.

Hormone	Function/Relationship with other hormones
hCG	maintains corpus luteum to keep estrogen and progesterone levels high and block menstruation
estrogen	works with progesterone to maintain endometrium and nourish embryo/fetus; high levels suppress production of prolactin
progesterone	works with estrogen to maintain endometrium and nourish embryo/fetus; high levels suppress production of prolactin
prostaglandins	cause release of oxytocin; work with oxytocin to cause uterus to contract
oxytocin	works with prostaglandins to cause uterus to contract throughout labour; also causes contractions within the mammary lobules
prolactin	stimulates milk production within a few days of birth

### Answers to Applying Concepts Questions

18. “Morphogenesis” refers to the formation or generation of the distinct structures of the developing organism. (Morphogenesis means “shape creator”, or “producer of forms.”) It could be inferred that organogenesis refers to the generation or formation of organs. Morphogenesis is a more comprehensive term that recognizes the cellular differentiation that includes the formation of organs as well as all of the other structures of the organism.
19. The students’ responses should include the fact that they are looking at data reflecting the development of embryonic and fetal structures and the organism’s sensitivities to teratogens during the entire prenatal period. (They should include a brief definition of teratogens and why they matter.) The information at the top of the graph shows when development of the various organs takes place during the pregnancy. The line graph shows the level of relative sensitivity to teratogens during pregnancy. Together, the information shows the vulnerability of organs to the effects of teratogens. The students should note that the heart, brain, skeleton, and mouth are being developed when the sensitivity to teratogens is at its peak. The genitals are formed at a less vulnerable time, and the brain and skeleton, which

continue to develop throughout the pregnancy, remain under threat, although at decreasing rates of sensitivity.

20. The endometrium thickens during the menstrual cycle to prepare for the implantation of the zygote (fertilized egg) when it reaches blastocyst form. Fertilization, however, takes place in the oviduct, not the uterus.
21. An embryo is unlikely to survive an ectopic pregnancy because, as the sites on the diagram indicate, even if the zygote implants, the endometrium (in the uterus) is needed to nourish the embryo and develop support structures such as the placenta. In addition, the uterus is designed to expand to accommodate the fetus. In an ectopic pregnancy, the embryo would be growing in an area that is not designed to accommodate a growing organism, and ruptures and other damage are likely to occur, endangering the mother’s life.
22. The drug may inhibit the production of prolactin. With the decrease in prolactin levels, the mammary glands will quit producing milk. Or the drug may inhibit the production of oxytocin, which will stop the contractions of the mammary lobules, causing the milk to stop flowing.
23. In addition to being viable, sperm must overcome some very high odds to reach the egg (e.g., being in the oviduct that has an egg; surviving the acidic environment of the female reproductive tract; and dissolving a path through the jelly-like protective membrane of the egg) so very large quantities of viable sperm are required in order to succeed. When the initial quantity of sperm is less than 10 million, it is unlikely that fertilization will occur.

### Answers to Making Connections Questions

24. Ovulation takes place on day 14 of a cycle, so she is approximately 30 days into her pregnancy. Gastrulation is complete; neurulation has begun (to form the spinal cord and brain), as has organ formation. Limb buds are present; development of the placenta and the umbilical cord are underway, and the developing embryo will have a heart beat (day 18).
25. Inadequate secretion of GnRH would result in inadequate production of FSH and LH, which stimulate gamete production and ovulation respectively. Treatment to mimic the action of GnRH is part of the infertility treatment called superovulation. Due to the increased release of FSH and LH, more follicles will mature within the ovary, each releasing an ovum. As a result, when she ovulates, more than one egg is released.
26. This is a higher order question that will require some inferences on the student’s part. Students’ diagrams should show only one zygote was formed. Monozygotic twins are identical because they are derived from the same zygote (thus monozygotic). The fact that there is only one chorion means there is only one placenta and should indicate that rather than there being an unexpected cleavage at some point, the key to unravelling the mystery

of identical twins lies in the blastocyst. Two inner cell masses in the blastocyst will lead to identical twins, unlike fraternal twins, which are the result of two eggs being fertilized.