

ACTIVITY 16-3. EMBRYONIC DEVELOPMENT

The development of the embryo begins after fertilization. It follows a well-defined pattern of growth and differentiation. Embryonic development is controlled, for the most part, by the genes—the hereditary material contributed by both parents. Development may occur either in the external environment or within the body of a parent.

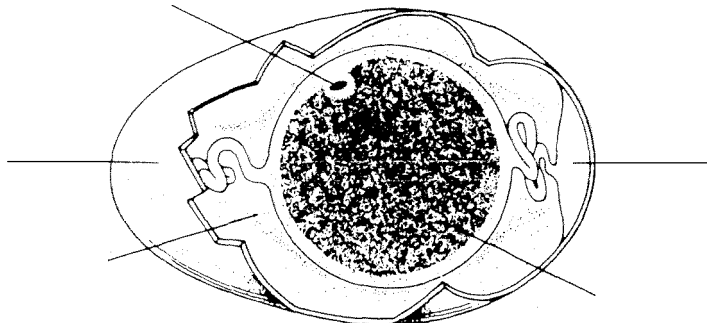
external development

In most fish and amphibians, eggs are fertilized externally in the water. The eggs and sperm of these animals are released in great number to ensure fertilization and the survival of some of the zygotes. The fertilized eggs develop in the water, utilizing food stored in the form of yolk. There is no protective shell around the egg, only a surrounding membrane. There is an exchange of materials between the inside of the egg and the environment through the membrane.

Reptiles, birds, and some primitive mammals produce shelled eggs. The eggs are fertilized internally and are then surrounded by the shell. In most cases the shell-covered egg is deposited outside the body of the female and the embryo develops externally. The developing embryo is nourished by the yolk stored in the egg. Birds incubate their eggs and care for their young after the eggs hatch. There are varying degrees of parental care in reptiles, while the primitive mammals incubate their eggs and care for their young.

Questions

1. The source of nourishment for developing fish embryos is _____, which is found in the _____.
2. Why are fish eggs and sperm released in such large numbers?
3. What are some of the advantages of the shelled eggs produced by birds and reptiles over the unshelled eggs of fish and amphibians?
4. Label the parts of the bird's egg indicated in the diagram below.



nonplacental internal development

In some fish and reptiles in which there is internal fertilization, the eggs are retained within the body of the female. When the eggs hatch, the young are released. There is also a small group of primitive non-placental mammals that are classified as *monotremes*. Members of this group, which include the duckbill platypus and the spiny anteater, lay reptile-like eggs that are retained inside the female for a short time. The eggs are then laid in a nest where development continues. When the young hatch, they are fed milk from the mother's mammary glands.

Pouched mammals, such as the kangaroo and the opossum, are classified as *marsupials*. After fertilization, the young are retained within the mother for a short period and are born in a very immature state. They crawl from the birth canal up to the pouch, where the mother's mammary glands are located, and become attached to a nipple. The young then continue their development in the incubator like environment of the pouch.

Questions

1. Egg-laying mammals are classified as _____. Such animals are found mainly in _____.
2. Pouched mammals are classified as _____.
3. How are newborn kangaroos nourished?

placental development

In most mammals, including humans, the embryo develops within the mother. It receives essential materials and eliminates wastes through a structure called the *placenta*. The placenta allows the diffusion of materials between the blood of the embryo and the blood of the mother. The young of placental mammals are cared for by the mother after birth and are fed milk from the mother's mammary glands.

Questions

1. What are the functions of the placenta?
2. Name three placental mammals other than humans.

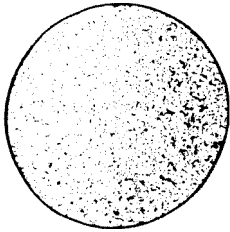
stages of embryonic development

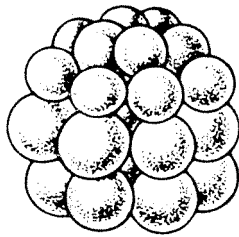
After fertilization, the zygote divides by mitosis into two cells. Mitotic division, which is called *cleavage* in embryos, continues, eventually forming a solid ball of cells. This is the *morula* stage. As cleavage continues, the center of the ball becomes hollow. This is the *blastula* stage. With still further cleavage, an inward growth of cells at a particular point results in the formation of a pocket, which pushes into the hollow center of the ball. This is the *gastrula* stage.

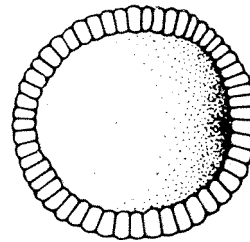
Within the double-walled gastrula three distinct layers of embryonic tissue--the *germ layers*---develop. The inner layer is the *endoderm*. The outer wall of the gastrula forms the *ectoderm*. And between the ectoderm and endoderm a middle layer called the *mesoderm* forms. The three germ layers form the tissues and organs of the developing organism. The cells differentiate, forming specialized types of cells, such as bone cells, nerve cells, and muscle cells.

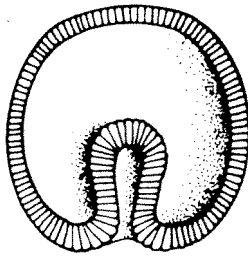
Questions

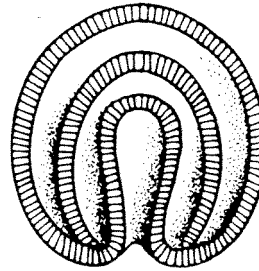
1. In the diagrams below, label each stage of embryonic development.











2. The three embryonic germ layers are the _____, _____, and _____.
3. Mitotic division in embryonic development is commonly called _____.

ACTIVITY 16-4. HUMAN REPRODUCTION

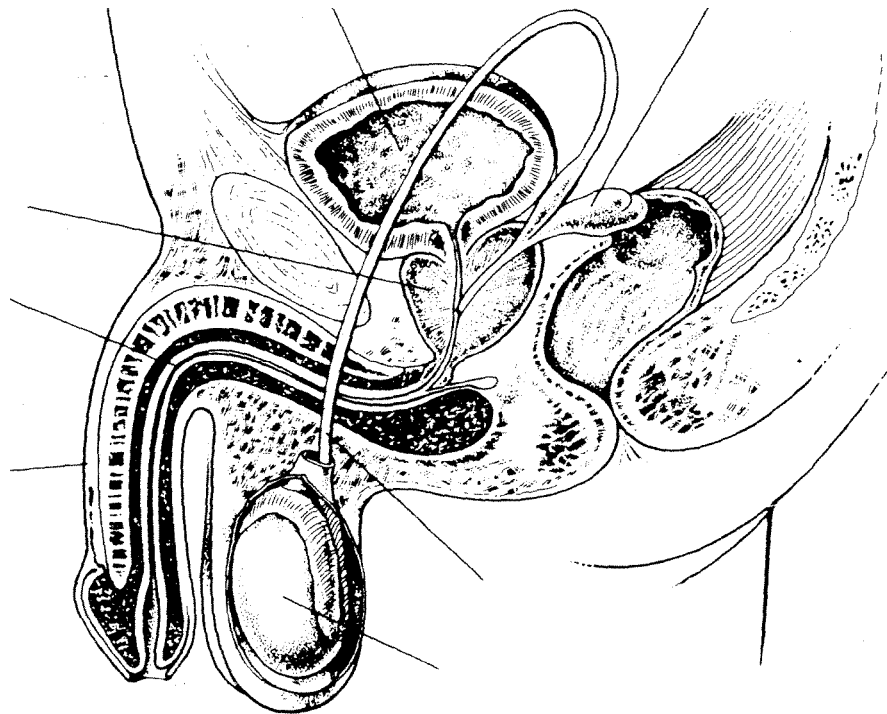
male reproductive system

The reproductive systems of human males and females are basically like those of other mammals. Fertilization and development are internal. The embryo develops within the female, where nutrients, oxygen, and other needed materials are supplied through the placenta from the blood of the mother. After birth, the baby is cared for by the parents and may be fed milk from the mother's mammary glands.

The pair of male gonads, the *testes*, are contained in a small pouch called the *scrotum*. The testes secrete the male sex hormones and they are the site of sperm production. The sperm are produced in the highly coiled *seminiferous tubules*. They pass from there to the *epididymis*, where they are stored. From the epididymis, the sperm enter the *vas deferens*, a tube that joins the urethra. Secretions from the *seminal vesicles*, the *prostate gland*, and *Cowper's glands* form a fluid that is a medium for the sperm. The sperm plus the secretions of these glands form the liquid *semen*. The semen is carried to the outside of the body by the urethra, which runs through the penis.

Questions

1. Label the parts indicated in the diagram below.



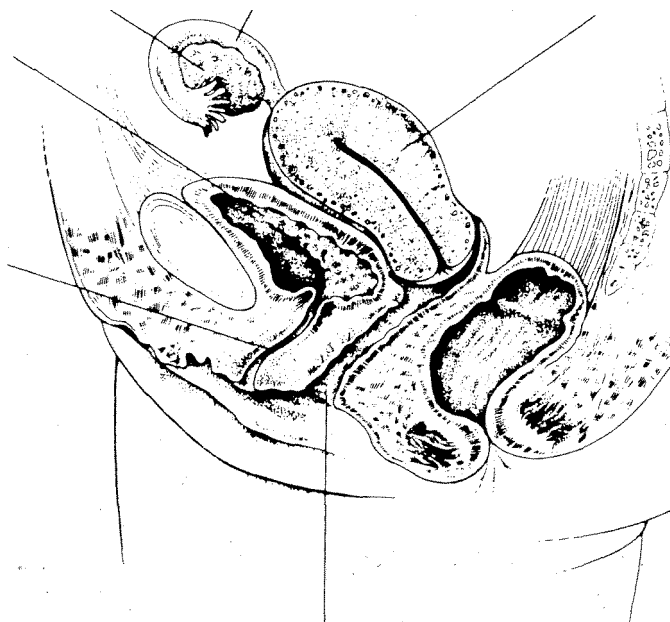
2. Sperm are produced in the _____
3. The three glands that add fluids to the sperm are _____, _____, and _____
4. The mixture of sperm and fluid secretions from glands is known as _____

female reproductive system

The female gonads, the *ovaries*, are located in the abdominal cavity close to the *oviducts*, or *Fallopian tubes*. The ovaries secrete female sex hormones and they are the site of development of the eggs, or ova. Eggs released from the ovaries are drawn into the oviducts by the action of ciliated cells. The oviducts lead into the uterus, a hollow, pear-shaped, muscular sac. At the bottom of the uterus is an opening surrounded by a muscular ring called the *cervix*. The cervix opens into a tube, the *vagina*, which opens to the outside of the body. The external female sex organs are known collectively as the *vulva*.

Questions

- I. Label the parts indicated in the diagram below.



2. Eggs are produced in the _____
3. Eggs enter the uterus through the _____
4. Development of the baby occurs within the _____

the menstrual cycle

Within the ovaries each egg is surrounded by a special cell called a *follicle*. About once a month, stimulated by follicle-stimulating hormone from the pituitary, one or more of the follicles fill with fluid. The follicle cells secrete estrogen, which causes the lining of the uterus to thicken in preparation for implantation of the embryo. Approximately two weeks after the last menstrual period, the follicle bursts at the surface of the ovary, releasing the egg. This is called ovulation. The egg passes into the oviducts. The space of the burst follicle is quickly filled with cells, forming the corpus luteum. The corpus luteum is stimulated by luteinizing hormone from the pituitary to secrete progesterone, which also stimulates the thickening of the uterine wall. If sperm are present, the egg may be fertilized while in the oviduct. If fertilization does occur, the egg passes into the uterus where it becomes embedded in the uterine wall and develops. In this case the corpus luteum is maintained and continues to secrete progesterone, which maintains the uterine wall.

If fertilization does not occur, the egg degenerates. Without fertilization, the corpus luteum also degenerates within about two weeks. Without the progesterone from the corpus luteum, the uterine wall breaks down, and the flow of menstrual blood begins. The flow consists of blood from broken vessels and pieces of the uterine lining. It lasts about four days. The progesterone secreted by the corpus luteum inhibits the development of follicles. When the corpus luteum degenerates, the progesterone level drops, and a follicle begins to ripen.

Questions

1. Eggs are contained within special cells called _____
2. The development of follicles is stimulated by the hormone _____, which is secreted by the _____
3. The cells of the follicle secrete the hormone _____
4. The release of the egg from the follicle is called _____
5. The menstrual cycle takes about _____ days.

pregnancy

Fertilization generally occurs in the oviducts, and development begins there.

Within about four days, the embryo enters the uterus, and by ten days the embryo has become implanted in the wall of the uterus. Cells on one side of the embryo form part of the placenta, while cells from the uterus form the other part of the placenta. The exchange of food, oxygen, and wastes between the mother's blood and the blood of the fetus occurs in the placenta. The embryo is attached to the placenta by the *umbilical cord*, which contains blood vessels. Surrounding the embryo is a membrane called the *amnion*. The space between the embryo and the membrane is filled with *amniotic fluid*, which serves to cushion and protect the embryo and provide it with a constant environment. Outside the amnion is another membrane, the *chorion*. A third membrane, the *allantois*, is found between the amnion and chorion.

After about six weeks, the embryo appears human in form. It is now referred to as a *fetus* rather than an embryo. The fetus grows and develops within the uterus.

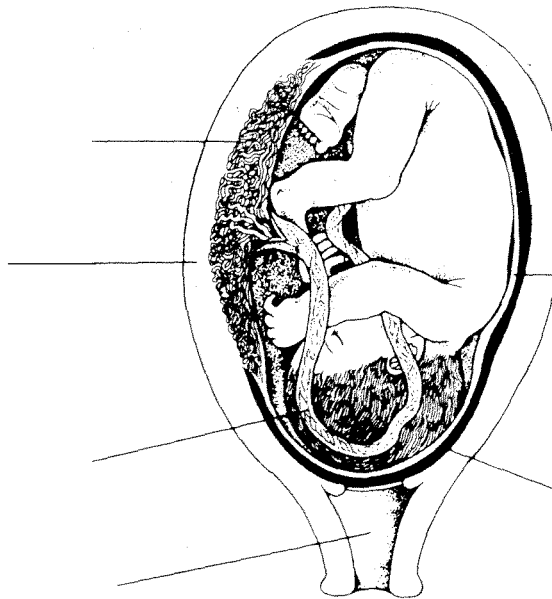
It is expelled by muscular contractions of the uterine wall about 38 weeks after fertilization. During birth, the vagina dilates, allowing the passage of the baby.

Occasionally, more than one infant is produced in a single pregnancy.

Identical twins are produced when the embryo separates in two during very early stages of development. Both halves develop, forming two separate individuals. Identical twins are always of the same sex and are physically very similar because of their identical genetic makeup. *Fraternal twins* occur when two eggs are released at about the same time and both are fertilized (by two different sperm). Fraternal twins are no more alike than ordinary siblings, and they may be of different sexes.

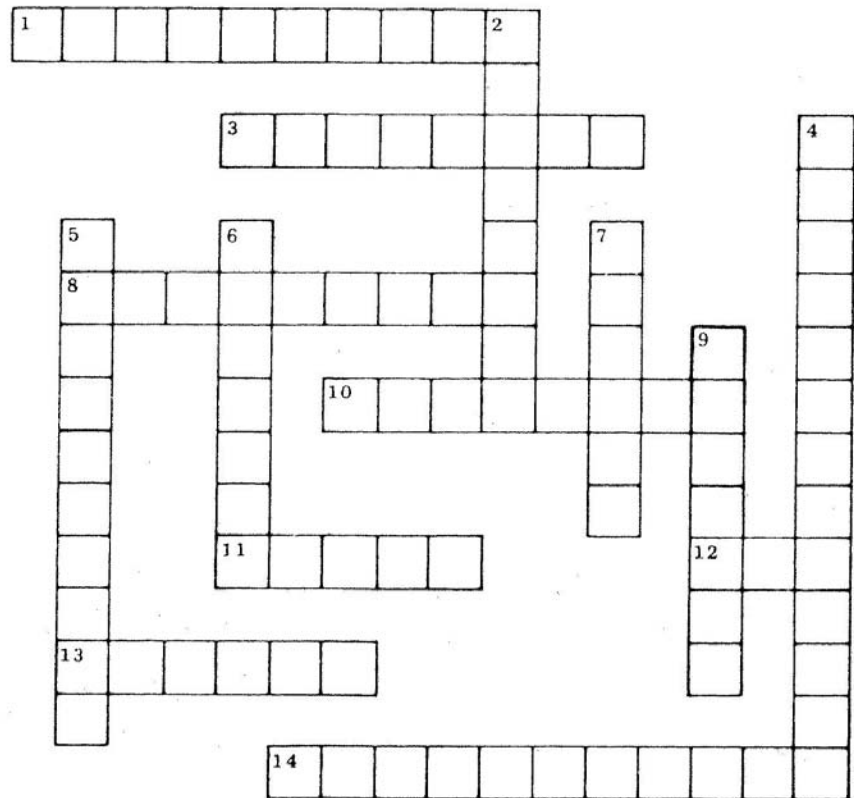
Questions

1. Label the parts indicated in the diagram below.



2. What is the gestation period for humans? _____
3. The embryo is attached to the placenta by the _____
4. In mammals, the yolk sac and allantois are important in the formation of the _____
5. What structures are found in the umbilical cord?
6. Twins that have developed from a single egg are called _____ twins, while twins that develop from two separate eggs are called _____ twins.

PUZZLE: UNIT 16



Across

1. Gametes of similar appearance.
3. Structure through which materials are exchanged between mother's blood and blood of fetus.
8. Process by which mature ova are produced.
10. Stage of embryonic development in which there is a hollow ball of cells.
11. Male gamete.
12. Female gametes.
13. Organ within which placental mammals develop.
14. Sexual process in which there is a union of gametes of similar appearance.

Down

2. The coming together of two double homologous chromosomes.
4. The union of heterogametes.
5. Two chromosomes of the same type, one from each parent, are _____ chromosomes.
6. Process by which chromosome number is reduced by half.
7. Stage of embryonic development in which there is a solid ball of cells.
9. The n, or _____, chromosome number.

REVIEW EXERCISES: UNIT 16

A. *Fill in the blanks in the statements below.*

1. The $2n$ number of chromosomes is also called the _____ number.
2. The union of two gametes results in the formation of a _____.
3. In meiosis, the process in which two pairs of homologous chromosomes form a tetrad is called _____.
4. In the first meiotic division, the chromosomes double _____ time(s).
5. In the second meiotic division, the chromosomes double _____ time(s).
6. The formation of sperm is called _____.
7. Sperm develop from unspecialized cells called _____.
8. The haploid nucleus of the sperm is found within the _____.
9. Sperm move by means of a _____.
10. Eggs develop from cells called _____.
11. In the formation of eggs, the meiotic divisions also produce smaller _____ bodies.
12. Two sex cells that are alike in appearance are called _____.
13. A sexual process found among protists in which there is an exchange of hereditary material is _____.
14. Two sex cells that are unlike in appearance, such as an egg and sperm, are called _____.
15. The union of a sperm and egg is called _____.
16. Two groups of organisms that produce shelled eggs are _____ and _____.
17. Egg-laying mammals are classified as _____.
18. In embryos, mitotic division is called _____.
19. Cleavage results in a developing organism called the _____.
20. The outer germ layer of a gastrula is the _____, the middle germ layer is the _____, and the inner germ layer is the _____.

B. *In the answer space for each question, write the letter of the choice that best completes the statement.*

- _____ 1. Two groups of animals that usually have external fertilization are (a) birds and mammals (b) fish and amphibians (c) amphibians and reptiles (d) reptiles and birds
- _____ 2. In which developmental stage do germ tissues form? (a) morula (b) blastula (c) fetus (d) gastrula
- _____ 3. Development of an ovum in the ovary is controlled by (a) follicle-stimulating hormone (b) estrogen (c) progesterone (d) luteinizing hormone
- _____ 4. Fertilization of a human egg establishes the (a) n chromosome number (b) $2n$ chromosome number (c) $3n$ chromosome number (d) $4n$ chromosome number

- _____ 5. Meiotic cell division (a) reduces chromosome number by half (b) maintains the original chromosome number (c) doubles the chromosome number (d) triples the chromosome number
- _____ 6. Which of the following are formed during oogenesis in mammals? (a) zygotes (b) spermatids (c) zygosporos (d) polar bodies
- _____ 7. In the course of meiosis, the (a) chromosomes replicate once and there are two cell divisions (b) chromosomes replicate once and the cell divides once (c) chromosomes replicate twice and there are two cell divisions (d) chromosomes replicate twice and the cell divides once
- _____ 8. Which of the following is a result of conjugation? (a) production of daughter cells (b) reduction in chromosome number (c) formation of spores (d) exchange of genetic material
- _____ 9. The stage of embryonic development in which there is a solid ball of cells is the (a) gastrula (b) morula (c) fetus (d) blastula
- _____ 10. The formation of sperm occurs in the (a) prostate gland (b) seminiferous tubules (c) epididymis (d) vas deferens
- _____ 11. In the ovary, each egg is surrounded by a special type of cell called a (a) corpus luteum (b) cervix (c) follicle (d) chorion
- _____ 12. The haploid number of chromosomes is the same as (a) n (b) $2n$ (c) $3n$ (d) $4n$
- _____ 13. The diploid number of chromosomes is the same as (a) n (b) $2n$ (c) $3n$ (d) $4n$
- _____ 14. Which of the following is the correct order? (a) secondary spermatocyte, primary spermatocyte, spermatid, sperm (b) primary spermatocyte, secondary spermatocyte, spermatid, sperm (c) spermatid, primary spermatocyte, secondary spermatocyte, sperm (d) primary spermatocyte, spermatid, secondary spermatocyte, sperm
- _____ 15. From the ovary the egg passes directly into the (a) uterus (b) Fallopian tube (c) follicle (d) corpus luteum
- _____ 16. The innermost germ layer is the (a) ectoderm (b) blastoderm (c) mesoderm (d) endoderm
- _____ 17. The middle germ layer is the (a) ectoderm (b) blastoderm (c) mesoderm (d) endoderm
- _____ 18. The outermost germ layer is the (a) ectoderm (b) blastoderm (c) mesoderm (d) endoderm
- _____ 19. Internal fertilization and external development are characteristic of (a) mammals and birds (b) mammals and reptiles (c) reptiles and fishes (d) birds and reptiles
- _____ 20. As a result of the first meiotic cell division (a) homologous pairs of chromosomes are separated (b) four daughter cells are formed (c) each daughter cell contains half the chromosome number of the parent cell (d) the daughter cells are identical to the parent cell