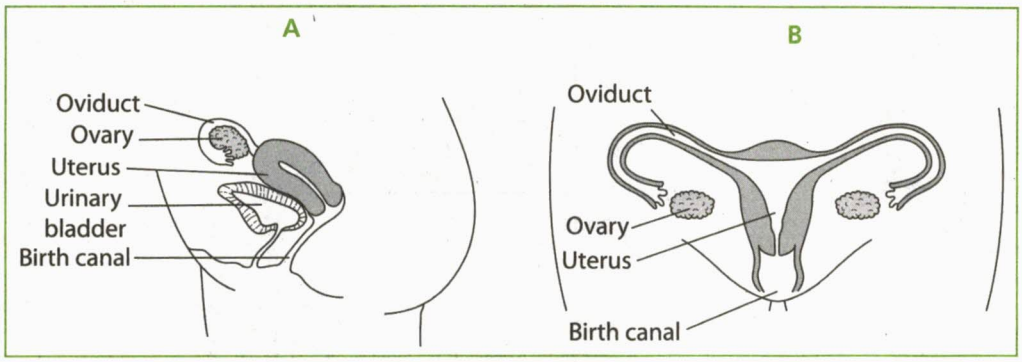


Figure 4-11. Two views of essential parts of the human female reproductive system and other structures: View A is from the side; View B is from the front.

Female Reproductive System The human female reproductive system is organized to produce gametes, to support internal fertilization and development, to exchange materials through the placenta, and to provide milk to the offspring.

In human females, the **ovaries** produce egg cells (female gametes) and the hormones **estrogen** and **progesterone.** These hormones are associated with sexual development and the reproductive process. The ovaries are located near the open ends of tubes called oviducts (egg ducts). The egg cell can be fertilized in the oviduct if sperm are present. The oviducts lead to the **uterus,** where the embryo develops into a fetus. The main parts of the female reproductive system are illustrated in Figure 4-11.

After the fertilized egg sinks into the thickened wall of the uterus, a placenta begins to form. The **placenta** is the organ responsible for the passage (by diffusion) of nutrients and oxygen from the mother's blood to the fetus. Wastes from the fetus also diffuse to the mother's blood through the placenta. During birth, the muscular uterus undergoes a series of contractions that eventually push the baby out of the mother's body. The early events of pregnancy are shown in Figure 4-12.

Male Reproductive System The **testes** of the male reproductive system are the organs that produce sperm cells. The testes also produce the hormone **testosterone,** which is associated with male sexual development and reproduction. Other structures associated with the male reproductive system produce the fluids and nutrients that are needed for the proper function and delivery of the male gametes to the female reproductive system. The essential parts of the human male reproductive system are shown in Figure 4-13.

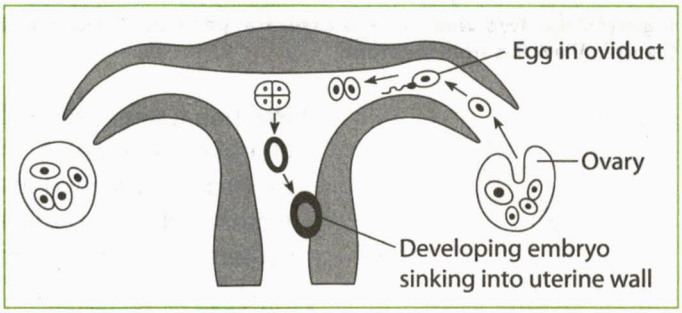


Figure 4-12. Early events of pregnancy: The egg released by the ovary travels down the oviduct where fertilization occurs. Mitotic divisions of the zygote begin as it continues to the uterus, where the developing embryo sinks into the uterine wall, and the placenta forms. The placenta will supply essential materials and remove wastes throughout the rest of the pregnancy.

Table 4-2. The Functions of the Parts of the Human Female Reproductive System

Structure	Function
Ovary	Produces egg cells; releases the hormones estrogen and progesterone
Oviduct	Site of fertilization; carries egg to uterus
Uterus	Site where embryo and fetus develop in association with placenta
Birth canal (vagina)	Site where sperm enter and swim to egg in oviduct; passageway for the birth of baby

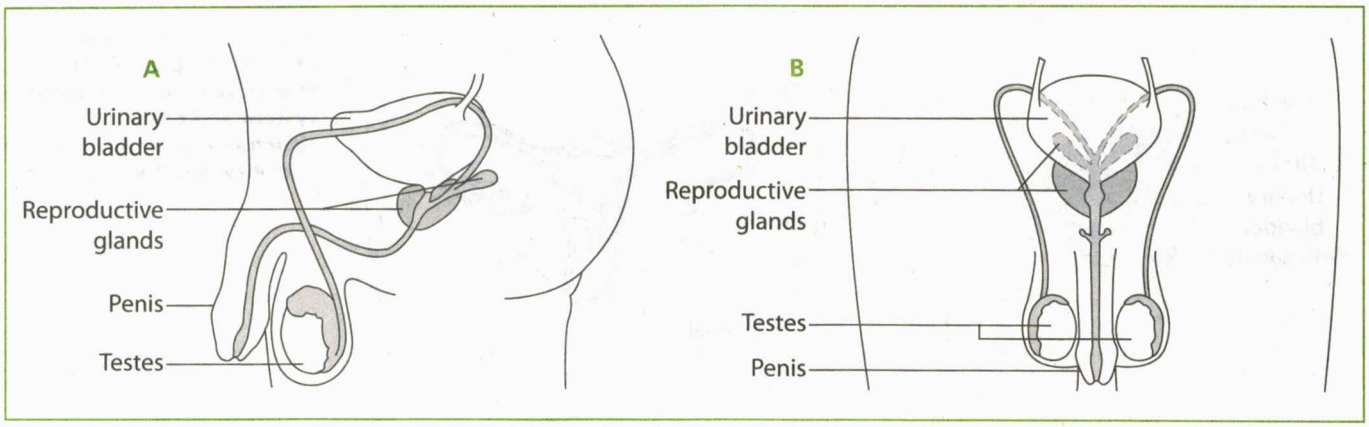


Figure 4-13. Two views of the essential parts of the human male reproductive system and other structures: View A is from the side; View B is from the front.

Hormonal Regulation The male reproductive system and other male characteristics, such as facial hair and a deep voice, that develop as sexual maturity is reached are influenced by several hormones, including testosterone from the testes. The development of the female reproductive system and female features, such as breast development and widening of the hips, also involves several important hormones, such as estrogen and progesterone.

Once sexual maturity is reached, females begin a regular cycle of about 28 days, during which an egg is released on about day 14. The timing of the events of this cycle is regulated by two hormones from the ovaries, along with several others from an endocrine gland in the brain. Figure 4-14 illustrates the changes in the level of several hormones associated with regulating this monthly cycle. The cycle varies slightly from individual to individual.

Although the interactions of the hormones are quite complex, estrogen and progesterone play important roles in the female reproductive cycle. Estrogen from the ovaries influences the sexual development of females. Together, estrogen and progesterone influence the preparation of the lining of the uterus so that a fertilized egg that embeds itself there can develop normally. Progesterone also maintains the uterine lining throughout pregnancy. For this reason, progesterone is often called the hormone of pregnancy. At the end of the cycle, if an egg is not fertilized, the levels of estrogen and progesterone decrease, and the lining of the uterus breaks down. Then the cycle begins again.

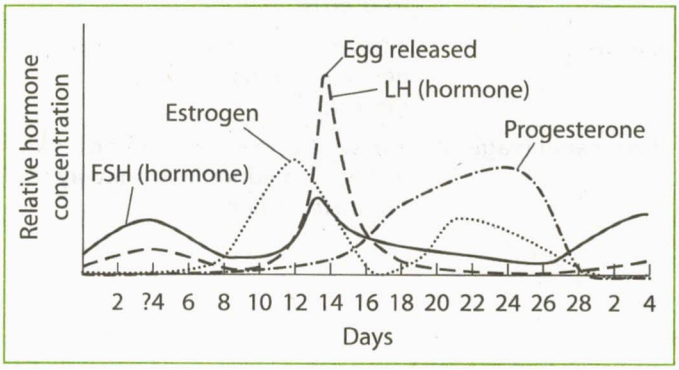


Figure 4-14. Hormones and events associated with the monthly reproductive cycle in human females: Notice the rise and fall in hormone levels at various times. These changes influence such events as the release of the egg from the ovary, the preparation of the uterus for a possible pregnancy, and the breakdown of the uterine lining if no pregnancy occurs. Remember that the timing of this cycle is NOT the same for everyone.

Human Development As with most other mammals, embryonic development continues in the uterus. Figure 4-15 shows some of the features of the uterus during pregnancy.

During the first part of pregnancy, cells continue to divide by mitotic division and begin to differentiate, forming tissues and organs. The placenta and a fluid-filled sac that cushions and

protects the developing embryo both form at this time, too. After about two months, when all the major organs have begun to form, the embryo is called a **fetus.**

During the first few months, when essential organs are forming in the embryo, things can go wrong. Problems associated with either the embryo's inherited genes or the mother's exposure to various harmful environmental factors can affect the embryo. Harmful environmental factors that a woman should avoid at any time during pregnancy include alcohol, drugs, and tobacco. Use of these can lead to the birth of a baby with brain damage, drug addiction, and/or low birth weight and the problems associated with it. An embryo or fetus may also be harmed if the mother has a poor diet, is exposed to certain toxic substances, or gets certain infections, such as German measles or AIDS.

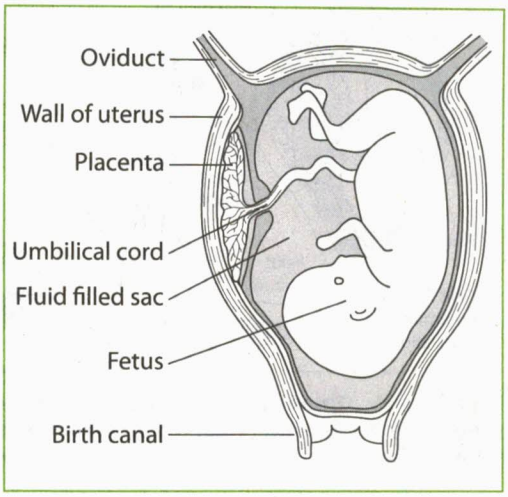


Figure 4-15. The uterus during pregnancy

After birth, cell differentiation and body growth continue until adulthood. During adulthood, the structures of the body slowly begin to age. Eventually, the organism weakens and dies. This process of birth, growth, development, aging, and death is a predictable pattern that applies not just to humans, but to all organisms.

Applications of Reproductive Technology

Recent discoveries by scientists have greatly changed the way we can deal with many problems involving the reproduction of humans as well as plants and other organisms. The knowledge we have gained has a variety of agricultural, ecological, and medical applications.

In the field of agriculture, scientists have produced plants that are resistant to insects, weed killers, and even frost. Such altered plants can then be cloned to produce thousands of genetically identical offspring. Using artificial insemination, scientists can generate hundreds of offspring from one farm animal. They can also freeze the sperm or fertilized eggs of an animal and transport them to animals thousands of miles away, at far less cost than transporting the animals themselves.

In the field of ecology, reproductive technology is being used to help build up populations of endangered species. Embryos from the endangered species have been transplanted into related species, who later give birth to offspring that are no different than they would be if they developed in the bodies of the endangered animals themselves. Also, hormones of insects that regulate their reproduction and development have been studied in an attempt to find ways to control insects without using poisonous chemicals.

In the field of medicine, recent scientific discoveries have led to new ways of dealing with reproductive problems in humans, other animals, and plants. Some women cannot become pregnant because of problems with their hormones, ovaries, or other parts of their reproductive systems. Reproductive technologies have enabled doctors to help infertile women become pregnant by using hormone therapy to adjust their hormones to normal levels. Sometimes doctors can extract several eggs from a woman's ovaries and fertilize them with sperm in a laboratory dish. When these

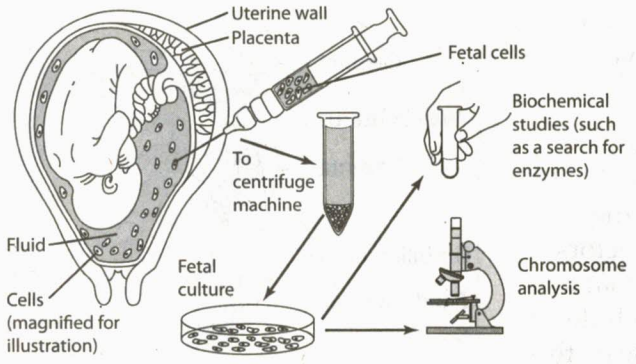


Figure 4-16. Obtaining fetal cells and fluids during pregnancy: Biochemical studies and chromosome analysis of the fetus can be done with cells and fluids removed during pregnancy.

fertilized eggs are implanted in the woman's uterus, a successful pregnancy may result.

Ultrasound and miniature video cameras allow doctors to view ovaries, oviducts, and other reproductive structures, or even a developing fetus, to determine if or where problems exist. Methods have also been developed to retrieve fetal cells that are present in the fluids around the developing fetus. (See Figure 4-16.) Doctors can then analyze the cells for chromosome abnormalities and the fluids for biochemical deficiencies that may threaten the health or development of the fetus.

Review Questions

32. What substances are involved in controlling the production of sperm and eggs in humans?

(1) vitamins (3) starches
(2) hormones (4) minerals

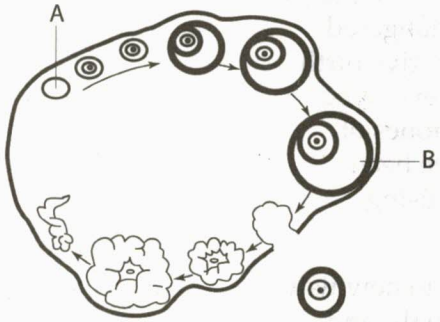
33. Which practice is essential to good prenatal care?

(1) increased egg production
(2) frequent dieting
(3) avoidance of drugs
(4) intake of antibiotics

34. Which part of the human male reproductive system produces hormones that influence the development of male sex characteristics?

(1) penis (3) gametes
(2) testes (4) ovaries

35. The diagram below represents a sequence of events in a human ovary.



The process that occurs between stage A and stage B is known as

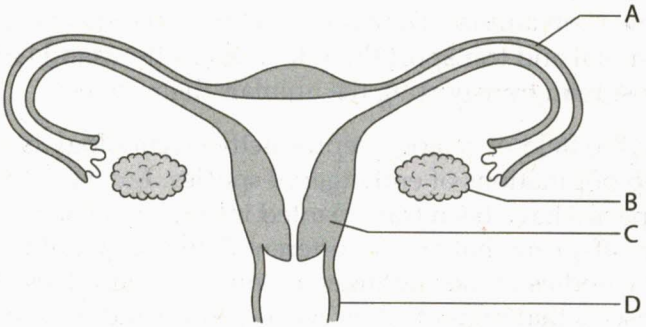
(1) egg formation (3) mitotic cell division
(2) sperm formation (4) cell recombination

36. The diagram below represents a series of events that takes place in the life cycle of humans.

Which term best describes the event taking place in the box labeled X?

(1) fertilization (3) meiosis
(2) immune response (4) protein synthesis

Base your answers to questions 37 through 41 on the diagram below and on your knowledge of biology. The diagram represents the human female reproductive system.



37. Fertilization usually occurs within structure

(1) A (2) B (3) C (4) D

38. A placenta normally develops in structure

(1) A (2) B (3) C (4) D

39. The structure that produces estrogen and progesterone is

(1) A (2) B (3) C (4) D

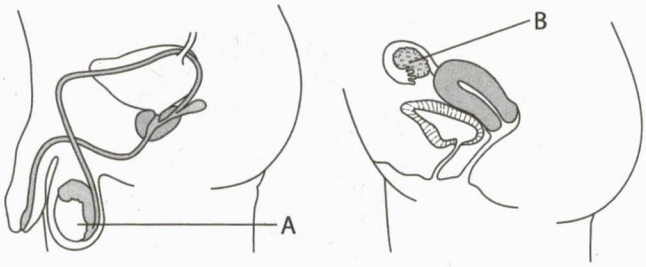
40. The structure that produces egg cells is

(1) A (2) B (3) C (4) D

41. Shortly after implantation, tissue from the embryo normally grows into the wall of

(1) A (2) B (3) C (4) D

Base your answers to questions 42 through 44 on the diagram below and on your knowledge of biology. The diagram represents the human male and female reproductive systems.



42. Gametes are produced in

(1) A, only
(2) B, only
(3) both A and B
(4) neither A nor B

43. Estrogen and progesterone are produced in

(1) A, only
(2) B, only
(3) both A and B
(4) neither A nor B

44. A substance is produced that influences both the reproductive cycle and the development of sex characteristics in

(1) A, only
(2) B, only
(3) both A and B
(4) neither A nor B

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45. In humans and other mammals, nutrients are transferred from the mother's bloodstream to the embryo's bloodstream across the

(1) placenta
(2) uterus
(3) ovary
(4) intestine

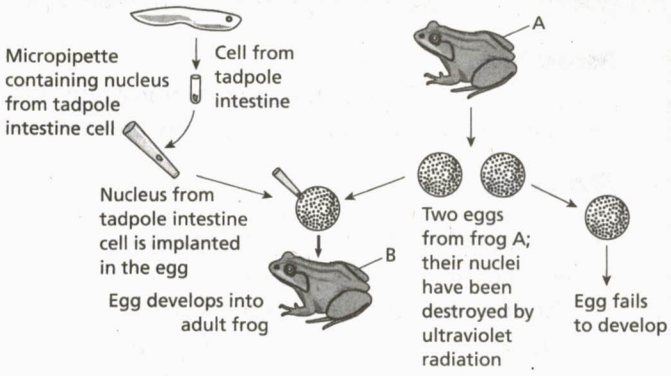
46. Which substance is a waste that would normally diffuse across the placenta from the embryo to the mother?

(1) glucose
(2) oxygen
(3) amino acid
(4) carbon dioxide

47. The egg of a mammal is smaller than that of a bird because the embryo of the mammal obtains its nutrients from the

(1) placenta through the process of diffusion
(2) mammary glands of the mother
(3) blood of the mother when it mixes with the blood of the embryo
(4) yolk stored in the uterus of the mother

Base your answers to questions 48 and 49 on the diagram below, which represents an experiment, and on your knowledge of biology.



48. An inference that can be made from this experiment is that

(1) adult frog B will have the same genetic traits as the tadpole
(2) adult frog A can develop only from an egg and a sperm
(3) fertilization must occur in order for frog eggs to develop into adult frogs
(4) the nucleus of a body cell fails to function when transferred to other cell types

49. Other scientists substituted a nucleus from a frog sperm cell and no adult frog developed. Explain why a sperm cell nucleus would not work in this procedure. [1]

Base your answers to questions 50 through 52 on the information below and on your knowledge of biology.

Some women have a blockage in that portion of their reproductive tract where fertilization of the egg cell would normally occur. *In vitro* fertilization is a technique that has been developed to make it possible for such women to bear their own children. This technique involves fertilizing an egg in a sterile petri dish and then implanting the developing embryo into the mother.

50. To ensure that the mother will have mature egg cells available for *in vitro* fertilization, she must be treated with chemicals that regulate her reproductive cycle. Identify these chemicals that regulate the female reproductive cycle. [1]

51. Egg cells for *in vitro* fertilization must be surgically removed from the mother. Identify the structure in the body of the mother that is the source for these egg cells. [1]

52. An embryo that developed from *in vitro* fertilization would be implanted in the mother's

(1) ovary (2) uterus (3) stomach (4) placenta