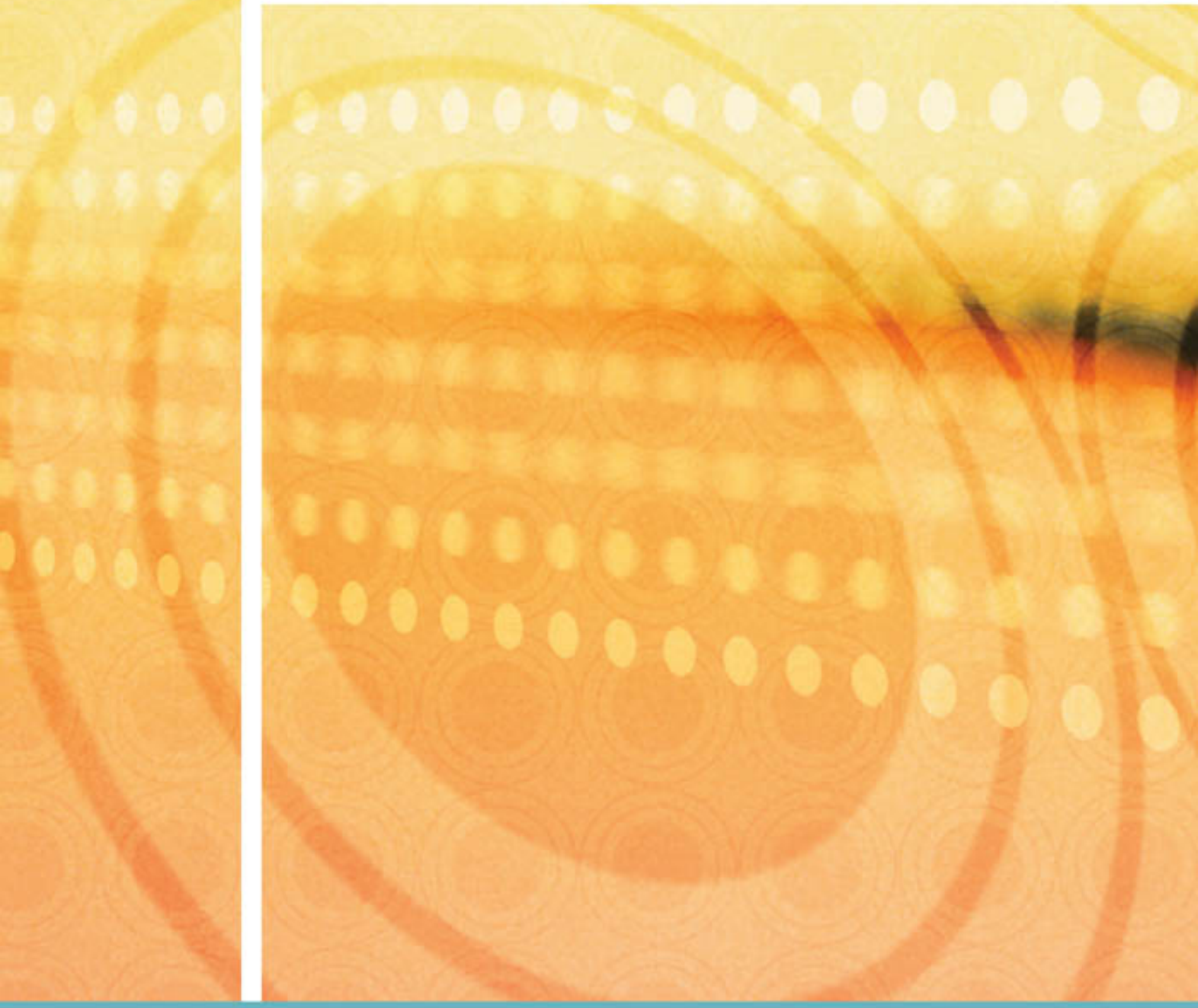
Pearson New International Edition

Scientific Farm Animal Production

Robert E. Taylor Tom G. Field

Tenth Edition



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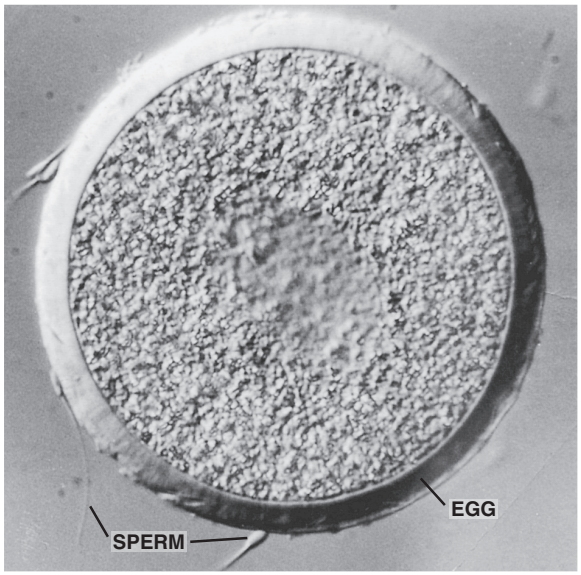

Figure 4
Bull sperm and cow egg magnified 300×. The ovum is about ⅟₂₀₀ in. in diameter, while the sperm is ⅟₆₀₀₀ in. in diameter. Each is a single cell and contains half the chromosome number typical of other body cells. Source: Courtesy of Colorado State University.

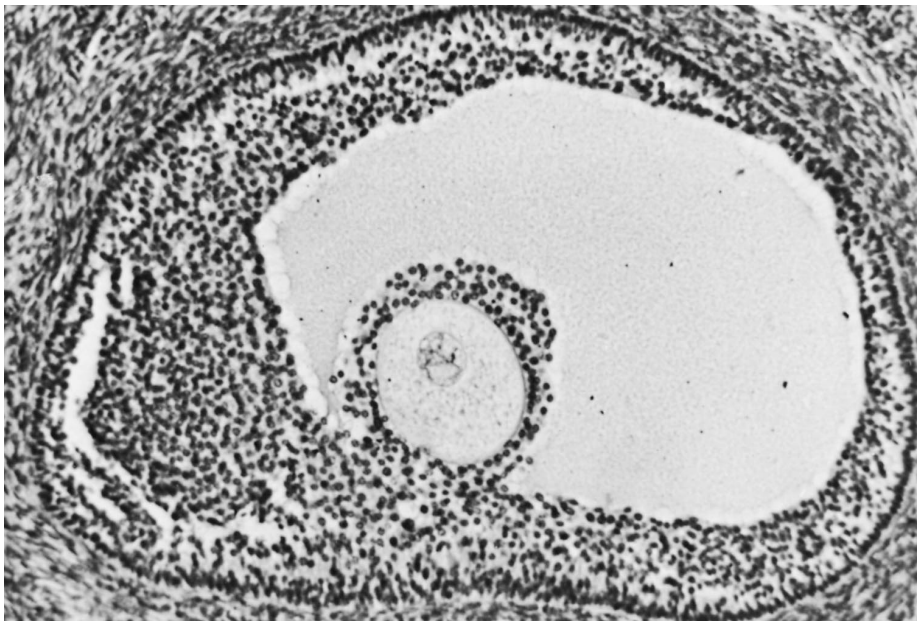

Figure 5
The large structure outlined with a circle of dark cells is a follicle located on a cow's ovary (magnified 265×). The smaller circle, near the center, is the egg. The large light gray is the fluid that fills the follicle. When the follicle ruptures, the egg will move into the oviduct by anatomical action of the infundibulum. Source: Courtesy of Colorado State University.

After the ovum is released from the mature follicle, cells of the follicle change into a **corpus luteum**, or "yellow body." The corpus luteum produces progesterone, which becomes a vitally important hormone for maintaining pregnancy.

The Oviducts

Immediately after ovulation, the ova are caught by the fingerlike projections of the **infundibulum**, which guide the ova into the tubular portion of the oviduct. The ova are tiny (approximately ⅟₂₀₀ in. in diameter, about the size of a dot made by a sharp pencil). Sperm are transported through the uterus into the oviduct after the female is inseminated (naturally or artificially). Therefore, the oviducts are where ova and sperm meet to initiate fertilization. After fertilization, three to five days are required

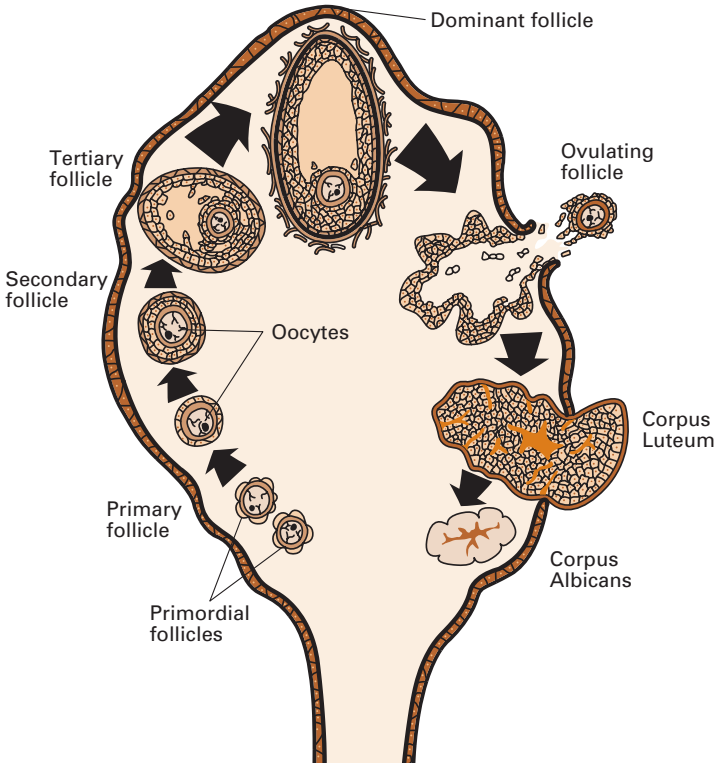

Figure 6
The progression of follicular development from primordial stage to ovulation, formation of the corpus luteum, and the formation of the corpus albicans once the CL regresses. Source: Sean Field.

in cows and ewes (about the same amount of time in other farm animals) for the ova to travel down the remaining two-thirds of the oviduct. From the oviduct, the newly developing embryos pass to the uterus and soon attach to its lining.

The Uterus

The uterus varies in shape from the type that has long, slender left and right horns, as in the sow, to the type that is primarily a fused body with short horns, as in the mare. In the sow, the embryos develop in the uterine horn; in the mare, the embryo develops in the body of the uterus. Each surviving embryo develops into a fetus and remains in the uterus until **parturition** (birth).

The posterior outlet of the uterus is the cervix, an organ composed primarily of connective tissue that constitutes a formidable gateway between the uterus and the vagina. Like the rest of the reproductive tract, the cervix is lined with mucosal cells. These cells undergo significant changes as the animal experiences the various phases of the estrous cycle as well as the process of pregnancy. The cervical passage changes from being tightly closed or sealed in pregnancy to a relatively open, very moist canal at the height of estrus.

The Vagina

The vagina serves as the female organ of copulation at mating and as the birth canal at parturition. Its mucosal surface changes during the estrous cycle from very moist when the animal is ready for mating to almost dry, even sticky, between periods of heat. The tract from the urinary bladder joins the posterior ventral vagina; from this juncture to the exterior vulva, the vagina serves the dual role of a passageway for the reproductive and urinary systems.

The Clitoris

A highly sensitive organ, the clitoris is located ventrally and at the lower tip of the vagina. The clitoris is the homologue of the penis in the male (i.e., it came from the same embryonic source as the penis). Some research indicates that clitoral stimulation or massage following artificial insemination in cattle will increase the chance of conception.

Reproduction in Poultry Females

The hen differs from farm mammals in that the young are not suckled, the egg is laid outside the body, and there are no well-defined estrous cycles or pregnancy. However, variation in day length does affect poultry reproductive rates. Since eggs are an important source of human food, hens are selected and managed to lay eggs consistently throughout the year.

The anatomy of the reproductive tract of the hen is shown in Figures 7 and 8. At hatching time, the female chick has two ovaries and two oviducts. The right ovary and oviduct do not develop. Therefore, the sexually mature hen has a well-developed ovary and oviduct only on the left side. The ovary appears as a cluster of tiny gray eggs or yolks in front of the left kidney and attached to the back of the hen. The ovary is fully formed, although very small, when the chick is hatched. It contains approximately 3,600–4,000 miniature ova. As the hen reaches sexual maturity, some of the ova develop into mature yolks (yellow part of the laid egg). The remaining ova are variable in size from the nearly mature to microscopic.

The oviduct is a long, glandular tube leading from the ovary to the **cloaca** (common opening for reproductive and digestive tracts). The oviduct is divided into five parts: (1) the infundibulum (3–4 in. long), which receives the yolk; (2) the

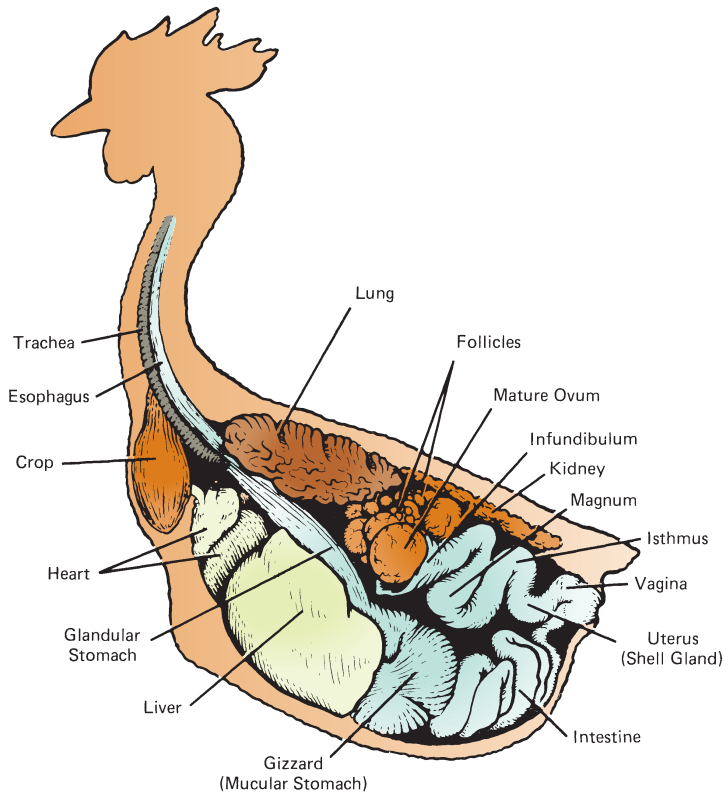

Figure 7
Reproductive organs of the hen in relation to other body organs. The single ovary and oviduct are on the hen's left side; an underdeveloped ovary and oviduct are sometimes found on the right side, having degenerated in the developing embryo.

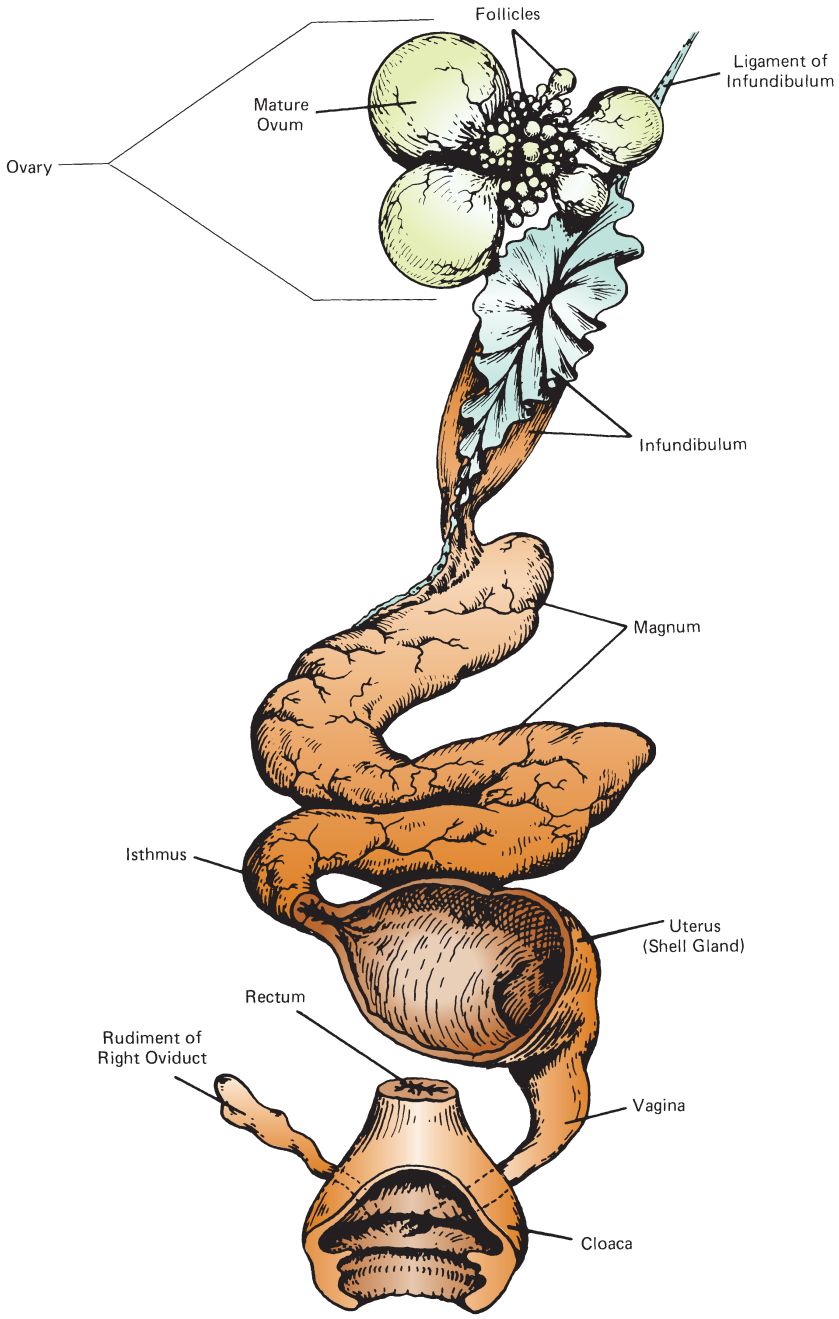

Figure 8
Reproductive organs of the hen. Sections of the uterus and cloaca are cut away to better view internal structure.

magnum (approximately 15 in. long), which secretes the thick albumen, or white, of the egg; (3) the **isthmus** (about 4 in. long), which adds the shell membranes; (4) the uterus (approximately 4 in. long), or shell gland, which secretes the thin white albumen, the shell, and the shell pigment; and (5) the vagina (about 2 in. long).

Ovulation is the release of a mature yolk (ovum) from the ovary. When ovulation occurs, the infundibulum engulfs the yolk and starts it on its way through the 25–27-in. oviduct. The yolk moves by peristaltic action through the infundibulum into the magnum area in about 15 minutes.

During the 3-hour passage through the magnum, more than 50% of the albumen is added to the yolk. The developing egg passes through the isthmus in about

1¼ hours. Here water and mineral salts and the two shell membranes are added. During the egg's 21-hour stay in the uterus, the remainder of the albumen is added, followed by the addition of shell and shell pigment. Moving finally into the vagina, the fully formed egg enters the cloaca and is laid. The entire time from ovulation to laying is usually slightly more than 24 hours. About 30 minutes after a hen has laid an egg, she releases another yolk into the infundibulum, and it will likewise travel the length of the oviduct.

After the fertilized egg is incubated for 21 days, the chick is hatched. The egg is biologically structured to support the growth and life processes of the developing chick embryo during incubation and for 3–4 days after the chick is hatched.

There are several egg abnormalities that occur because of factors affecting ovulation and the developmental process. Double-yolked eggs result when two yolks are released about the same time or when one yolk is lost into the body cavity for a day and is picked up by the infundibulum when the next day's yolk is released. Yolkless eggs are usually formed when a bit of tissue that is sloughed off the ovary or oviduct stimulates the secreting glands of the oviduct and a yolkless egg results. The abnormality of an egg within an egg is due to reversal of direction of an egg by the wall of the oviduct. One day's egg is added to the next day's egg, and shell is formed around both. Soft-shelled eggs generally occur when an egg is laid prematurely and insufficient time in the uterus prevents the deposit of the shell. Thin-shelled eggs may be caused by dietary deficiencies, heredity, or disease. Glassy- and chalky-shelled eggs are caused by malfunctions of the uterus of the laying bird. Glassy eggs are less porous and will not hatch but may retain their quality.

MALE ORGANS OF REPRODUCTION AND THEIR FUNCTIONS

Figures 9 and 10 show the reproductive organs of the bull and boar. The organs of reproduction of a typical male farm mammal include two **testicles**, which are held in the scrotum. Male sex cells (called **sperm** or *spermatozoa*) are formed in the **seminiferous tubules** of the testicles. The sperm from each testicle then pass through

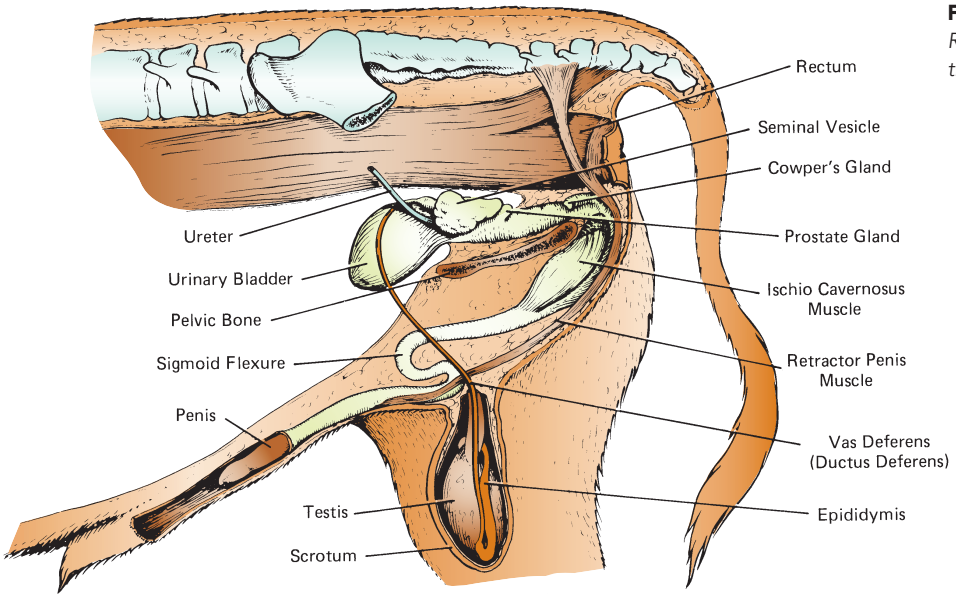

Figure 9
Reproductive organs of the bull.

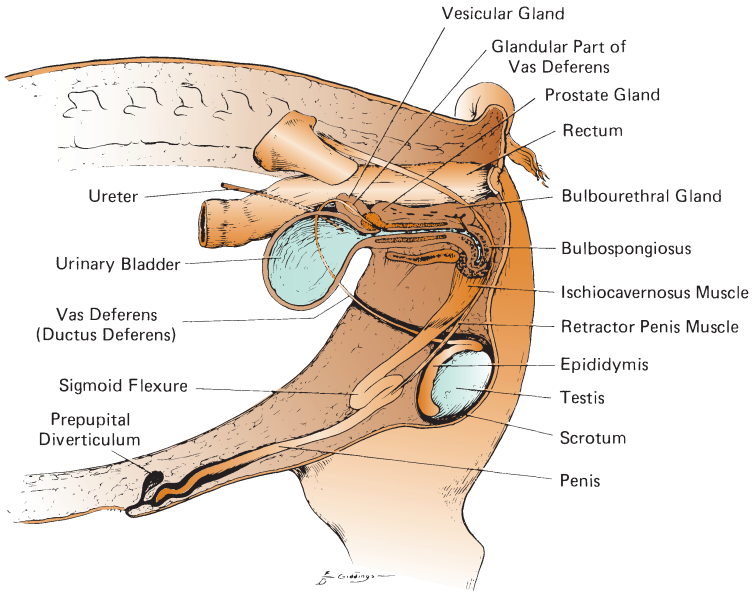

Figure 10
Reproductive organs of the boar.

Table 2
SUMMARY OF THE PRIMARY FUNCTIONS OF THE MALE REPRODUCTIVE TRACT

Organ	Primary Function(s)
Testicles	Testosterone production (interstitial cells) Spermatozoa production (seminiferous tubules)
Epididymis	Concentration, storage, maturation, and transport of spermatozoa
Scrotum	Support of testicles Temperature control (tunica dartos)[a]
Vas deferens	Sperm transport
Accessory glands	Addition of fluid volume, nutrients, and buffers to semen
Penis	Copulatory organ

[a]The cremaster and pampiniform plexus of the spermatic cord also assist with temperature regulation of the testes.

a ductal system into the **epididymis**, which is a highly coiled tube that is held in a covering on the exterior of the testicle. The epididymis functions to concentrate, store, transport, and facilitate maturation of sperm cells. The epididymis empties into a larger tube, the **vas deferens** (also called the **ductus deferens**). The two vasa deferentia converge at the upper end of the urethral canal, where the urinary bladder opens into the urethra. In some species, the wall of the upper end of the vas deferens is thickened and forms a secretory gland called the **ampulla**. The urethra is the large canal that leads through the penis to the outside of the body. The penis has a triple role: It serves as a passageway for semen and urine and it is the male organ of copulation.

The left and right parts of the seminal vesicles, which lie against the urinary bladder, consist of glandular tissue that secretes into the urethra a substance that supplies nutrients for the sperm. The prostate gland contains 12 or more tubes, each of which empties into the urethra. Another gland, the bulbourethral (Cowper's) gland, which also empties its secretions into the urethral canal, is posterior to (behind) the prostate. Table 2 outlines the primary activities of the male reproductive organs and tissues. Table 3 summarizes the comparative anatomical and seminal differences of males for several species.