

BASICS OF LIFE

BY LES SELNOW

Reproduction in all species borders on the miraculous. How else can one describe a process where two infinitesimal entities, one from the male, the other from the female, join forces to produce living, breathing offspring?

Reproductive capability or success varies by species. Mice and rabbits, for example, are prolific producers of offspring. Horses, on the other hand, fall into a category where it is much more chancy.

When horses ran wild, this wasn't a serious problem. There were so many of them that their numbers continued to expand even though birth rate often was dictated by the availability of food and water. Once the horse was domesticated, however, organized reproduction became the order of the day. Stables that depend on selling the offspring of stallions and mares have an economic stake in breeding success. Yet, the process continues to be less than perfect, with success rates hovering in the 65-70% range, and sometimes lower.

In this article on reproductive anatomy, we'll take a look

at the reproductive organs of both the mare and the stallion and discuss just how they function in their effort to produce another "miracle." Once again, sources are too numerous to mention, other than to say that much of the basic information on reproduction available today stems from research at such institutions as Colorado State University, Texas A&M University, and the University of Minnesota. There are many others involved in reproductive research, but much of the information utilized in this article emanated from those three institutions.

The Mare

We'll begin with the mare because her role in the reproductive process is more complicated than that of the stallion. Basically, the mare serves four functions:

- 1) She produces eggs or ova;
- 2) She provides housing and nourishment for the developing embryo, which becomes a fetus;

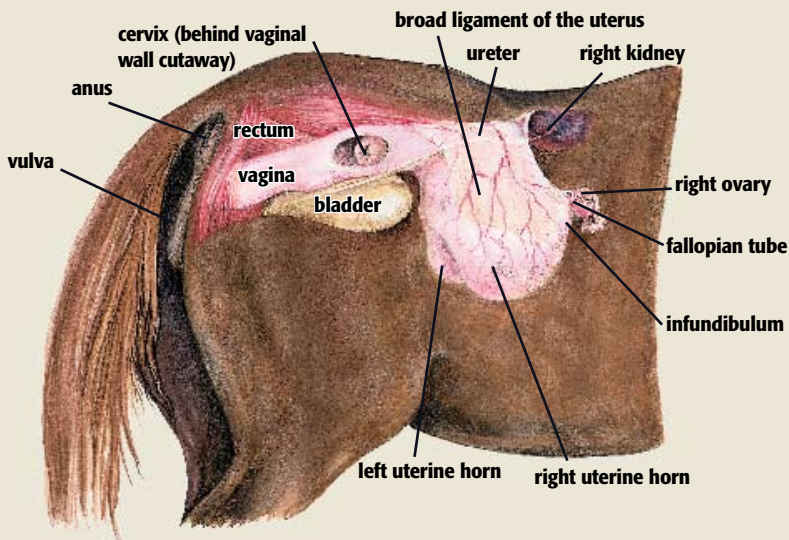
A handy guide to the male and female reproductive tracts

Editor's Note

This is the final article in a 12-part series on equine anatomy and physiology. If you missed any part of the series, be sure to look for the PDF version on TheHorse.com in the coming months.

DR. ROBIN PETERSON ILLUSTRATION

The Mare's Reproductive Tract



DR. ROBIN PETERSON

- 3) When the fetus reaches a certain state of maturity, the mare expels it at the time of birth or parturition; and
- 4) The mare produces milk for nourishment of the young.

The mare's reproductive tract lies in a horizontal position within the abdominal and pelvic cavities. The key elements are the vulva, vagina, cervix, ovaries, oviducts, and uterus.

Vulva The vulva is the external opening of the reproductive tract. The labia are the lips of the vulva on each side of a five- to six-inch vertical slit located below the anus.

Vagina The vagina is comprised of a six- to eight-inch long muscular tube lined with mucous membranes. It connects the vulva to the cervix. The tissues of the vagina are very elastic so that it can accommodate the stallion's penis during breeding and passage of the foal during the birthing process.

Cervix The cervix provides entrance to the uterus at the end of the vagina. The cervix is about four inches long and forms a boundary between the inside and outside world with folded tissue.

When a mare is in estrus, the cervix is flaccid and open to facilitate the passage of semen. When the mare is out of estrus, the cervix is tightly closed and serves as a barrier to prevent foreign agents from

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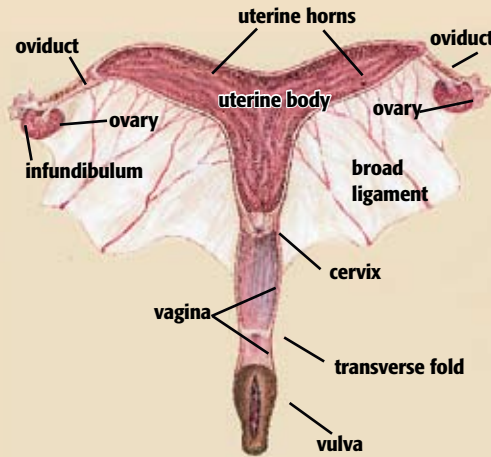
Ovary The primary sex organ of the mare is the ovary. She has two of these organs that are shaped somewhat like beans and are two to three inches in length.

The ovaries are located at the forward or upper end of the reproductive structure. Their job is to produce eggs. When a female horse is born, her ovaries contain all of the egg cells that her body will ever produce. Each egg is contained in a little bubble-like container on the ovary called a follicle.

Generally speaking, not much happens with the follicles until the filly reaches puberty. At that point, one or more of the follicles will begin to grow as the result of an increase in fluid within the follicle. Normally, if nature is left to its own design, the rest of the follicles will remain small and quiescent until it is their turn.

Oviducts When the egg reaches a particular point of maturity, the follicle ruptures and the egg is discharged. The egg is

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then trapped in the infundibulum, a funnel-shaped membrane that surrounds the ovary.

The infundibulum narrows and becomes a coiled tube known as the oviduct. The oviduct connects to the uterus and carries the egg to that location in the wake of fertilization.

Uterus The uterus is the largest of the female reproductive organs and is capable of expansion as the fetus grows and develops. The uterus is multi-layered, hollow, and Y-shaped. The base of the Y is the uterine body, while the two branches are known as horns. Two tough, sheet-like structures, known as broad ligaments, suspend the uterus within the body cavity. There are three distinct layers in the uterus. The outermost is continuous with the broad ligaments and is known as the serous layer. The middle layer is comprised of muscular tissue and is called the myometrium. These muscles are responsible for pushing the foal into the birth canal during parturition. The innermost

layer is the endometrium, a complex mucosal membrane that contains a rich blood supply and many glands. It is the role of the uterus to house and nourish the developing fetus.

The Role of Light

A key element in the "miracle" of birth



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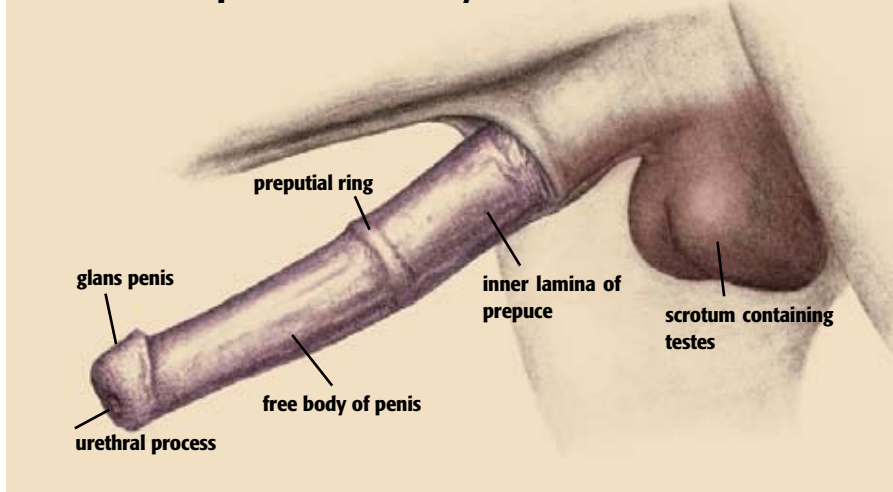
is light. The mare's reproductive activity is seasonally polyestrous, which means that she has a reproductive season and a non-reproductive season. Both are controlled by light.

The non-reproductive season is known as anestrus and comes in the fall and winter when there is little light. The reproductive season begins in the spring when days are longer, and it lasts into the summer.

However, the seasons are not all that cut and dried. In between those two basic seasons are two other cycles, known as transitional stages. One occurs just before the mare becomes reproductively active and the other occurs just prior to anestrus. During these two periods, mares generally are erratic in their cyclic and sexual behavior.

Light jump-starts the reproductive system by stimulating the hypothalamus gland located within tissues at mid-brain to produce gonadotropin-releasing hormone

The Stallion's Reproductive Anatomy



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(GnRH). When enough GnRH is produced, the pituitary gland at the base of the brain is stimulated. The pituitary then secretes two hormones—follicle stimulating hormone (FSH) and luteinizing hormone (LH)—that act on the ovaries. Follicle stimulating hormone moves via the bloodstream to the ovaries, where it stimulates the production of one or more follicles.

When the follicles reach 20 to 25 milli-

meters in diameter, they secrete estrogen, which stimulates sexual activity within the mare. It serves to prepare the reproductive tract and cervix for the arrival of sperm and causes the mare to be receptive to the stallion's sexual advances.

Luteinizing hormone facilitates maturation and ovulation of the growing, egg-bearing follicle. Ovulation occurs when the mature egg leaves the follicle and be-



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gins its trip through the oviduct and into the uterus.

In the wake of ovulation, the estrogen level falls and the remains of the ovulated follicle are converted to form a corpus luteum (CL) or yellow body (a temporary glandular mass). Granulosa cells in the CL secrete the hormone progesterone. Its job is to shut down the secretion of the estrus-stimulating hormones and set the stage for maintenance of a pregnancy.

As progesterone carries out its tasks, the cervix closes, contractions along the reproductive tract cease, and the mare loses all interest in the stallion's advances.

What happens next is dependent on whether the mare became pregnant. If she did, progesterone will continue to function in its role of maintaining the pregnancy by suppressing other hormonal activity.

However, if the mare does not become pregnant, changes will take place to prepare the way for another try at pregnancy. The uterus will remain under the influence of progesterone for 12 to 14 days, but after that the uterus reacts.

If the mare is not pregnant at that stage, the uterine endometrium will secrete the hormone prostaglandin. The first thing prostaglandin will do is destroy CL that is producing progesterone. With progesterone production shut down, the level of FSH will rise to the point where the whole cycle is started over again.

What has been described above is the way a healthy mare's reproductive system normally functions when left to its own design. However, it should be noted that some mares produce insufficient progesterone, and that a wide variety of malfunctions can occur along the way.

The Stallion

The stallion's prime function in the reproductive process is two-fold:

- 1) To produce the male reproductive cells known as sperm or spermatozoa, as well as produce the male sex hormone testosterone; and
- 2) To introduce sperm into the female reproductive tract at the proper time.

The prime sex organs of the stallion are the testes or testicles, of which there are two. Each testicle is suspended by the spermatic cord that extends from the abdomen to its attachment on the testicle.

The testicles are normally ovoid (like an egg) and will measure 80 to 140 millimeters in length and 50 to 80 millimeters in width. Each will weigh about 225 grams.

The testicles are housed in the scrotum,

which is an out-pouching of the skin. It is comprised of two scrotal sacs—one for each of the testicles—and it is separated by a septum. The scrotal sacs are located on either side and in back of the penis.

The penis is the male organ of copulation and is comprised of three parts—the root, which attaches the penis to the pelvis via two strong ligaments and a pair of muscles; the body or shaft, which is the main portion of the penis; and the glans penis, which is the enlarged front end of the penis.

The major portion of the penis is formed by the corpus cavernosa (a pair of

sponge-like columns of erectile tissue that becomes engorged with blood during erection). The corpus spongiosum is a small area of spongy erectile tissue that immediately surrounds the urethra. It also becomes engorged with blood during erection. The glans penis is filled with a multitude of nerve endings and becomes engorged and erect during sexual excitement.

When not erect, the stallion's penis is approximately 50 centimeters in length and 2.5 to five centimeters in diameter. The penis is contained within the sheath or prepuce, which forms two folds around

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the free end of the penis.

During erection, the size of the penis will increase about 50%. However, the glans penis “flowers” or “bells” and increases in size between 300-400% during erection.

The testicles are formed within the abdominal cavity and, in the normal colt, descend into the scrotum between 30 days before birth and 10 days after birth.

The testicle is covered with a thick layer of connective tissue called the tunica albuginea. Fused to the outer surface of this capsule is the thin visceral vaginal tunic. Supporting strands of connective tissue extend from the tunica albuginea

to divide the testicles into lobules.

The non-capsular part of the testicle is called the parenchyma. It consists of seminiferous tubules (capable of producing and conveying semen) and interstitial tissue situated between the seminiferous tubules. Located within the seminiferous tubules are Sertoli cells. They are involved with the production of spermatozoa. In the adult stallion, billions of spermatozoa are produced daily in the convoluted seminiferous tubules.

After leaving the seminiferous tubules, the spermatozoa travel to the epididymis, which is lightly attached to the upper

surface of each testicle.

Located in the interstitial tissue between the seminiferous tubules are Leydig cells. Their prime function involves the production of testosterone.

There are three basic processes involved in the release of semen on the part of the stallion—erection, emission, and ejaculation. Erection has been discussed. Emission is the movement and deposition of sperm and fluid from the deferent duct and tail of the epididymis as well as fluids from the accessory sex glands, into the pelvic urethra. Ejaculation is the actual expulsion of the semen out through the urethra. In the stallion, ejaculation occurs as a series of strong pulsing contractions so that several successive “jets” of semen are spurting forth.

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There are three basic processes involved in the release of semen on the part of the stallion—erection, emission, and ejaculation.

Conclusive Act

We are now at a logical conclusion. The mare's hormonal system has allowed her to be receptive to the stallion's advance. The cervix is open and relaxed. Ovulation is on schedule. The stallion does his job and sperm is ejaculated.

So, one might say, that for sure means a pregnancy. Not necessarily. There is a delicate time balance involved. The sperm cells live only 24 to 30 hours in the reproductive tract of the mare. The timetable is even tighter for the egg or ova. The egg remains viable for only four to six hours.

Thus, one can say, when pregnancy, followed by birth of a live foal, does occur, it is indeed a “miracle.”

ABOUT THE AUTHOR

Les Sellnow is a free-lance writer based near Riverton, Wyo. He specializes in articles on equine research, and he operates a ranch where he raises horses and livestock. He has authored several fiction and non-fiction books, including Understanding Equine Lameness, Understanding The Young Horse, and The Journey of the Western Horse, published by Eclipse Press and available at www.ExclusivelyEquine.com or by calling 800/582-5604.