For all things there is a time and a season. Nowhere is this more true than in equine reproduction. Nature has established a definite time and season for mares to conceive and bear foals. It is a very sensible approach on the part of Mother Nature. The mare is most fertile and receptive to a stallion in the warming days of late spring and early summer. Because of her 11-month gestation period, this means that, if bred during that period, she will give birth to a foal when the grass is green and the sun is warm upon the Earth. So much for what Mother Nature has dictated. Man, through the years, has had other ideas.

The purpose of this primer is not so much to discuss man's tinkering with equine reproduction as it is to provide basic information on a mare's normal estrous cycle. To begin at the beginning, we must first discuss the physical makeup of this complicated, but sometimes effective reproductive system.

We are indebted to reports from Sheryl S. King, PhD, of Southern Illinois University-Carbondale, and to research at Colorado State University for much of the information that follows.

**The System**

Each portion of the mare's reproductive tract plays a key role in reproduction. Included are the vulva, vagina, cervix, uterus, oviducts, and ovaries. Problems with, or timing malfunctions of, any of these essential components can result in a mare which has difficulty getting pregnant or, if she does become pregnant, cannot carry the foal to term. The mare's reproductive tract lies in a roughly horizontal position within the abdominal and pelvic cavities. First in line is the vulva, which is the exterior opening to the reproductive canal. The vulva consists of the labia, clitoris, and vestibule. The way in which the vulva is constructed and positioned and the ability of the vulva lips or labia to seal tightly is highly important in preventing air and debris from entering the reproductive tract. If, for example, the vulva is tipped in, fecal material will fall against the labia whenever the mare defecates. This can result in the reproductive tract becoming contaminated and infected. Or, the labia might lose elasticity and be unable to seal tightly, allowing air-borne contaminants to make their way into the reproductive tract. The labia or lips of the vulva meet in a five- to six-inch vertical slit located below the anus. This vertical position, plus the muscle tone of the labia, helps keep the lips tightly closed.

The clitoris is a small, knob-like structure located inside the labia and on the floor of the vulva.

The vestibule is the internal portion of the vulva and extends about four inches to the interior. It is separated from the vagina by a fold of tissue, which includes the hymen. This fold is located just forward of the urethral opening. Glands within the vestibule secrete mucus that lubricates and protects the vulva and vagina.

The vagina is a six- to eight-inch long muscular mucous membrane-lined tube that runs between the vestibule and the cervix. Because of its need to accommodate the penis during breeding and the foal during birth, vaginal tissues must be very elastic.
At the interior end of the vagina is the cervix, which serves as a physical barrier between the vagina and uterus. The cervix is approximately four inches long and appears as a circle of folded tissue at the anterior surface of the vaginal vault. When the mare is in heat or estrus and her body produces additional estrogen, there is a strong blood flow through the tissues of the cervix and it appears pink in color. Also during this period, the cervix is completely relaxed, facilitating the passage of semen into the uterus and the insertion of breeding instruments during artificial insemination. At the same time, it produces copious quantities of a thin, watery mucus. Conversely, when the mare is not in estrus, the cervix is tightly closed. During this time it has a blanched appearance and produces a thick, sticky mucus. Instead of lying limply on the vaginal floor as it often does during estrus, it is held in the center of the vaginal wall. By sealing itself tightly, the cervix is protecting the uterus from the introduction of foreign matter. Because it serves as the first line of defense for the uterus, a strong and healthy cervix is vital to reproductive soundness.

Next is the uterus, a multi-layered, hollow, Y-shaped organ. The base of the Y is called the uterine body, while the two branches are called horns. Tough ligaments hold the uterus in place. Here again, nature's superb workmanship can be compromised by injury, disease, and advancing age. Sometimes the tough ligaments lose some of their supporting ability and the uterus tips downward. When this happens, there can be a backwash of urine into the reproductive tract, pooling at the cervix. The result can be uterine infection and low fertility.

The uterus is composed of three distinct layers. The serous layer is the outermost and is continuous with the broad ligaments that hold the uterus in place. The middle layer consists of two sheets of muscular tissue called the myometrium. It is the myometrium that is responsible for the powerful contractions at birth. The inner layer is the endometrium. It is a complex mucosal membrane with a rich blood supply and many glands, all of which are designed to nurture and protect the growing fetus.

Here, too, nature's handiwork can be compromised. A healthy uterus houses, protects, and feeds the fetus, but when it is damaged and scarred as the result of multiple births, infection, or injury, it can no longer do its job properly. The result can be infertility, embryonic death, or a foal which is weak and in poor condition when born.

Next are the oviducts or fallopian tubes. They are tiny, highly coiled tubes. There are two oviducts, with each one connecting the tip of a uterine horn to an ovary. The portion of the tube connecting to the ovary is known as the infundibulum. It is enlarged and shaped a bit like a catcher's mitt. It has finger-like projections that are known as fimbriae. Its unique design envelopes or cradles the portion of the ovary from which the egg (ovum) will emerge, so that the egg can be captured and transported down the oviduct to the uterus. Fertilization of the egg occurs in the oviduct in the area below the infundibulum, which is known as the ampulla. The portion of the oviduct where it narrows to join the uterus is known as the isthmus.

Both oviducts are lined heavily with hairlike projections called cilia. They beat rhythmically to assist in transporting the egg along the oviduct and to facilitate movement of sperm in the opposite direction, putting egg and sperm on Nature's version of a collision course.
On to the ovaries. A mare has ovaries that are unique, both in shape and makeup. They are shaped like a kidney bean and vary in size, depending on whether the mare is in estrus or is going through that phase where her reproductive system has shut down for the season--anestrus.

During the period of sexual activity, the ovaries swell up to the size of tennis balls. During inactivity, they shrink and become harder to the touch. The convex side of the kidney bean-shaped ovary is called the bilus. This is the spot where the ovary is attached to the abdominal cavity. The blood vessels and nerves that serve the entire ovary pass through this region. The concave side of the ovary contains an area unique to mares--the ovulation fossa. It is only from this wedge-shaped area that an egg or ovum can be shed or ovulated.

There are two layers involved in the inner structure of the ovary. The outermost area is the medulla, which contains nerves and the blood supply. The inside of the ovary is known as the cortex. This is the area that contains the eggs or ova.

When a filly is born, the ovarian cortex already contains all of the egg cells that she will possess in her lifetime.

One of the structures within the cortex is the follicle. Each egg or ovum is encased in a single layer of follicular epithelial cells. This structure is called a primordial follicle. Only a small fraction of the primordial follicles present at birth will reach maturity and liberate (ovulate) their ova.

Another structure within the cortex is the corpus luteum. It forms from the tissues remaining after a follicle ruptures at ovulation. The corpus luteum secretes the hormone progesterone.

**The Estrous Cycle**

Now that we have the mare's reproductive physiology in mind, we can begin talking about the estrous cycle and the roles played by the various reproductive components. First, we must face the fact that mares are not the most efficient reproductive machines in nature. A part of this probably stems from the complicated system involved, but a good deal of blame must go to humans, who often do not select stallions and mares for reproductive capabilities, but rather for their ability to run at speed, jump high into the air, stop a cow in the middle of a cutting pen, or any one of a number of other reasons that have nothing to do with the ability to reproduce.

In addition, man has sought to change nature's approach so that mares come into season and give birth in months when their reproductive systems normally would be shut down. Most wild bands of mares have a higher level of reproduction success than do their domestic counterparts.

A mare's reproductive activity is described as being seasonally polyestrous. This means that, basically, she has a reproductive season and a non-reproductive season. The non-reproductive season--anestrus--is during late fall and winter. During this time, a mare will not respond to a stallion's attention. Many will pin their ears, squeal, kick, and strike if a stallion approaches. As mentioned earlier, their ovaries are inactive and reduced in size. During the reproductive season, the mare's attitude changes, at least on certain days, along with hormonal activity within her reproductive system. During this reproductive season, the mare will experience a series of estrous cycles. These cycles will repeat themselves at 21- to 23-day intervals until she becomes pregnant or until she reverts to anestrus during late fall and winter.
During these cycles there is, generally speaking, a five- to seven-day period when the mare is in estrus (or heat) and is receptive to a stallion. It is during this period that all components of her reproductive system are in synchronization, with pregnancy being the goal.

While there are two basic reproductive seasons, each of those two can be split once again, making four in all. As already mentioned, the natural season occurs during spring and summer, with the highest efficiency coinciding with the longest day of the year—June 24. During this period, nearly 100% of the mares will be cycling. The anestrus season is at its peak during the winter months, coinciding with days when there is relatively little light. During this period, only a small percentage of mares will cycle and ovulate.

The other two cycles are transitional stages that occur between the active season and the anestrus season. During this time, mares generally are erratic in their cyclic or sexual behavior.

**Cycle Control**

The estrous cycle during the active months is controlled by the interaction of various hormones within the body. However, it all starts with the eye, which allows the entry of light.

As spring approaches, there is an increase in day length and temperature. If the mare is living off the land as wild bands do, there also is an increase in the quality of nutrition as new grass starts to spring up.

As the mare's brain records the increased amount of light and higher temperatures, the hypothalamus gland located within tissues of the mid-brain is stimulated. It signals the start of the reproductive system by producing gonadotropic releasing hormone (GnRH). When GnRH is secreted in the proper quantity, the pituitary gland, located at the base of the brain, is stimulated. The pituitary is attached to the hypothalamus by a stalk containing both blood vessels and nerves, which serve as the pathway for communication with the hypothalamus.

The pituitary is a highly vascularized gland and, as such, can monitor levels of certain hormones in the bloodstream with a high degree of sensitivity. When it is stimulated, the pituitary gland secretes two hormones that affect the ovaries. The first hormone is known as follicle stimulating hormone (FSH). It travels along the bloodstream to the ovaries, where it stimulates development of one or more follicles. The now-developing follicles in the ovaries, when they reach the stage where they are 20 to 25 millimeters in diameter, secrete estrogen, which does the following:

1. Affects behavioral centers in the brain, stimulating estrual activity.
2. Affects the cervix, allowing relaxation for entrance of spermatozoa into the uterus.
3. Stimulates the smooth muscles in the mare's reproductive tract for increased contractions to transport sperm and ovum.
4. Affects the pituitary gland to inhibit further secretion of FSH and stimulating release of the second gonadotropic hormone—luteinizing hormone (LH).

The luteinizing hormone facilitates maturation and ovulation of the growing, egg-bearing follicle.

Studies at Colorado State have led researchers there to the conclusion that mares which cycle early in the spring frequently exhibit an erratic or extended estrus, often without ovulation. Many times a normal cycle is not established until later. This, they reason,
probably is due to the poor hormonal relationships at the beginning of the natural breeding season. In other words, it takes the mare a while to get her entire reproductive system synchronized.

As a result, pregnancy rates often are low during February and March.

Back to reproductive activity during the estrous cycle.

Ovulation, when the mature egg leaves the follicle and begins its trip through the oviduct, generally occurs late in estrus. Once ovulation occurs, the luteal phase of the estrous cycle is ushered in.

After ovulation, the estrogen level falls and the remains of the ovulated follicle are converted to form a corpus luteum (CL) or yellow body. This conversion begins immediately following ovulation, with the empty follicular cavity accumulating coagulated blood and forming the precursor to corpus luteum known as the corpus hemorrhagicum.

Luteal cells within the corpus hemorrhagicum grow toward the interior, eventually replacing the clotted blood with a solid core of luteal cells. When this is achieved, the structure is called a corpus luteum.

The luteal cells within the corpus hemorrhagicum and corpus luteum secrete the hormone progesterone. It is the job of progesterone to shut down the estrus-stimulating hormones and to set the stage for maintaining a pregnancy.

Its first task is to subdue the actively contracting reproductive tract and to tighten and close the relaxed and open cervix. At the same time, progesterone inhibits the secretion of FSH and LH from the pituitary. When this has been accomplished, the mare goes into a state of diestrus--out of heat. Her sexual behavior pattern changes radically. No longer is she receptive to the stallion. He is not welcome within sight or sound of her.

What happens next is dependent on whether the mare became pregnant. If she did not, the uterus will remain under the influence of progesterone for 12 to 14 days. Then changes will occur. If no embryo is present in the uterus at the end of that time, uterine endometrium will secrete the hormone prostaglandin. This hormone will destroy the corpus luteum that is producing progesterone. With the corpus luteum destroyed, no more progesterone is produced. Without progesterone as an inhibitor, the level of follicle stimulating hormone (FSH) rises, and the cycle starts all over.

If, however, a fertilized egg is present in the uterus, the corpus luteum is maintained and continues to secrete progesterone. On the 37th day, specialized cells from the fetal membranes (placenta) invade the lining of the uterus to form endometrial cups, which secrete the hormone PMSG--pregnant mare serum gonadotropin. This hormone is high in both follicle stimulating hormone and luteinizing hormone activity.

It is believed that the PMSG stimulates follicular development on the ovaries (since FSH is being suppressed), resulting in the formation of secondary corpus luteum. Secondary corpus luteum, along with the primary CL, produce progesterone necessary for the fetus to develop until day 160. However, the fetal membranes produce sufficient progestins from the 80th day to term to maintain pregnancy.

**Estrus**

Just how long a mare will remain in heat (estrus) varies horse by horse, but there are some general rules of thumb. In one Colorado State study, the sexual behavior of two groups of mares was studied. One group featured 35 mares and the other group contained 54. They were studied through a total of 7,713 teasings.
The researchers found that the average duration of estrus of normally cycling mares was 6.8 days. However, in the study groups, estrus ranged from two to 16 days, and one mare remained in heat for 24 days. Interestingly, the duration of estrus varied from cycle to cycle. The researchers reported that during the first cycle observed during the study, the average length of time the mares were in heat was 7.3 days. During the third cycle, the average dropped to 5.8 days. They also reported that there were no significant differences between duration of estrus over time in the months of May, June, July, or August. The average duration of diestrus—when the mare wasn't in heat—was 15 days. In the study, the average duration of the entire estrous cycle was 21.5 days, with ranges running from 13 to 30 days.

Another interesting fact emerged concerning length of estrus as it relates to pregnancy. In the study, it was found that the mean duration of estrus for mares which became pregnant was 7.5 days. For mares which did not become pregnant, the duration of estrus was 5.8 days.

After three years of study were completed, all of the results were pooled. Again, there were differences in the time mares were in heat relative to them becoming pregnant. It was found that in cycle 1, mares which became pregnant were in estrus an average of 8.2 days, which was significantly longer than seven days for mares which did not become pregnant. The same was basically true for mares which were bred in cycle 2. Mares which became pregnant were in heat an average of 7.7 days versus 6.2 days. However, that's where the disparity ended. There was no difference in the duration of estrus for mares bred during cycles 3 and 4.

Learn more about raising horses and mare care in the handy reference Understanding the Broodmare.

Overall, the figures averaged out to 7.5 days of estrus for mares which became pregnant compared to 6.5 days of estrus for nonpregnant mares. The lesson to be learned, one can surmise, is that a breeder must know the mare as an individual in order to properly interpret what is happening within that mare's reproductive system during each of her estrous cycles. With the information in this primer as a basis, the novice breeder can open new doors to expanded knowledge in the fascinating world of equine breeding. When that happens, the result will be a well-planned breeding program, plus a thoughtful approach to intelligent health maintenance so that the mare's entire reproductive system can function as one beautifully synchronized unit.