Estrous Cycle and Reproductive Hormones of the Cow

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This publication is designed as a teaching aid for the intensified cattle reproduction schools conducted by the Indiana Cooperative Extension Service. It is also included in the Beef and Dairy Production Handbooks for County Extension Workers. The purpose of this publication is to help producers more clearly understand the structure, functions, and abnormalities of the reproductive systems of the cow.

**Action of glands and hormones**

The step-by-step occurrence of the events in the estrous cycle are determined chiefly by hormones. Hormones are chemical substances produced by glands located in different areas of the body. Hormones are usually secreted into the bloodstream and carried with the blood from one part of the body to another. In this way, they serve as chemical messengers to regulate tissue and organ activity.

The hormones and glands which regulate the estrous cycle are closely inter-related. Checks and balances operate among the hormones which control the cycle. A simple diagram of an inter-relationship between two glands is illustrated in Figure 1.

![Diagram of hormonal relationships between three different glands](https://example.com/hormonal-diagram.png)

**Figure 1. Diagram of the hormonal relationships between three different glands.**

In this example, Gland A secretes Hormone A. Hormone A then acts on Gland B,
causing it to produce larger amounts of Hormone B. Hormone B cuts down the amount of Hormone A secreted by Gland A and also stimulates Gland C. The amounts or concentrations of Hormones A and B in the blood stream thereby rise and fall in a regular cyclic pattern. Castration, use of stilbestrol, and estrus synchronization are examples of changing the hormone balance for economic reasons.

**Pituitary gland**

The Pituitary Gland, located at the base of the brain, serves as a control gland in the scheme of reproduction. It is composed primarily of two parts, the anterior lobe and the posterior lobe.

The anterior lobe produces two gonadotrophic hormones: (1) follicle stimulating hormone (FSH) - stimulates growth and development of the egg in the cow’s ovaries and of sperm in the bull’s testes and (2) luteinizing hormone (LH) - stimulates release of the egg from the ovary, and in combination with FSH, promotes hormonal secretion by the follicle. In the bull, LH promotes the production and release of the male hormones (or androgens).

The posterior lobe releases a hormone called oxytocin which affects contractions of the uterus and milk let-down.

**Onset of sexual maturity**

Sexual Maturity, or puberty, is brought about by hormonal activities similar to those responsible for subsequent estrous cycles. Although the anterior pituitary produces both FSH and LH prior to puberty, ovulation does not occur. This is probably because the ratio of FSH to LH causes continuous growth of follicles, but not ovulation of mature eggs.

As puberty approaches, the ratio of FSH to LH becomes smaller, resulting in continued increases in the size of the follicles. When the follicles reach a certain point of maturity, another hormone, estrogen, is secreted by the cells surrounding the egg. The many functions of estrogen, the primary female hormone, are shown in Figure 2.

In the cow, the visual signs of estrus, which are promoted by estrogen are restlessness, mounting of other cows, standing to be mounted, and swelling of and secretions from the vulva.

As shown in Figure 2, estrogen also suppresses the secretion of FSH. The reduced secretion of FSH, and perhaps an increased secretion of LH, promotes ovulation.

Until puberty is reached, the growth of most of the female reproductive tract is quite slow. However, soon after puberty, there is an abrupt increase in the size and weight of the reproductive organs. It is a good practice to allow heifers to pass over at least two heat periods before breeding. However, the size of the heifer is more important than age in determining breeding time. Heifers should not be overfed, but should have a limited but adequate amount of a balanced growing ration. This helps to assure that the reproductive tract and the heifer herself is large enough to accommodate the developing fetus and that the heifer’s growth and development will not be impaired.
First heat usually occurs in heifers between 10 and 16 months of age, depending on level of nutrition and breed.

**Length of cycle and timing of service**

Each cow shows some individuality in the duration of the estrus period, length of the estrous cycle, and time of ovulation. However, most cows follow rather predictable patterns.

The signs of heat are usually visible for about 17 hours, but may vary from 4 to 30 hours. Occasionally, there is a "quiet ovulation" or "silent heat" in which ovulation occurs without visual signs of heat.

<table>
<thead>
<tr>
<th>Heat first observed</th>
<th>Best time to breed</th>
<th>Too late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning (Before 9:00 a.m.)</td>
<td>Same day</td>
<td>Next forenoon</td>
</tr>
<tr>
<td>Forenoon (9:00 a.m. - Noon)</td>
<td>Late same day or early next day</td>
<td>After 10:00 a.m. next day</td>
</tr>
<tr>
<td>Afternoon</td>
<td>Next forenoon</td>
<td>After 2:00 p.m. next day</td>
</tr>
</tbody>
</table>

*a/ Trimberger, G. W., Nebraska Agricultural Experiment Station Research Bulletin, No. 153, 1948.

**Subsequent estrous periods**

In the following estrous periods, ovulation is brought about in the same manner as in the onset of puberty. That is, FSH causes growth of the follicles and eggs, and LH promotes maturation and ovulation. Estrogen is produced by the follicles and suppresses the secretion of FSH.

Ovulation generally occurs about 12-14 hours after the end of the visible heat period. The egg and sperm must meet at the proper part of the oviduct at the proper time if the cow is to conceive. This is an important consideration in using artificial insemination or hand-mating.

The best time to breed is during the latter part of the heat period. Table 1 shows the best time to breed for good results. This assumes that the cows are checked for heat three times each day.

Another hormone, Progesterone, comes into play at ovulation. Progesterone is secreted by the corpus luteum or "yellow body" which is a group of cells that form in the cavity left by rupture of the follicle. The main known functions of progesterone are outlined in Figure 3.
uterus are through 70 to 120 small "buttons" or cotyledons.

Parturition and lactation

During the latter stages of pregnancy, preparations are made for the next two steps in reproduction, parturition and lactation.

Parturition occurs about 280 days after conception, but varies with breed, sex of calf, and several other factors. After the signs of labor have appeared, the fetus is usually expelled within 4 to 5 hours. If birth has not occurred within 12 hours after labor has started, help by an experienced person should be given the cow. The placental membranes should be expelled within 16 hours after delivery. Cows should be observed at least three times a day near parturition.

Near calving time, another hormone, prolactin, is secreted from the anterior pituitary and promotes initiation of lactation. Once initiated, lactation is apparently maintained by an additional mechanism involving the suckling stimulus and several hormones.

Milk production increases rapidly after parturition, reaching a peak in two to four weeks. From four weeks to five months following parturition, milk production gradually declines. After five months, the decline is more rapid.

After parturition, the cow must produce milk as well as prepare the reproductive tract for another conception. During pregnancy, the uterus increases greatly in size and weight. Before another successful pregnancy can occur, the female reproductive tract must be adequately repaired. The progress of uterine repair, involution, usually takes about 50 to 60 days. This means that there should be a lapse of at least two months between birth and rebreeding.

Figure 3. Diagram of the effects of progesterone produced by the corpus luteum on the ovary

If the cow does not conceive, the corpus luteum degenerates at about the 15th day of the estrous cycle. When the corpus luteum degenerates, progesterone concentration falls, FSH is no longer suppressed, and a new estrous cycle begins.

Usually, the cow has only one ovulation per estrous period. Over the lifetime of the cow, about 60 percent of the ovulations occur from the right ovary.

Pregnancy

The ovarian hormones, estrogen and progesterone, condition the uterus for receiving the fertilized eggs. The walls of the uterus are thickened and the blood supply increases.

The fertilized egg descends from the oviduct to the horn of the uterus within a period of about 4 days after breeding. During this time the fertilized egg starts to divide. On about the thirteenth day after breeding, the egg has undergone 4 or 5 divisions and consists of 16 to 32 united, similar cells. Attachment to the wall of the uterine horn also occurs around the thirteenth day.

A series of membranes, the placenta, develop around the embryo and serve to supply nutrients from the mother and to protect the embryo. The actual attachments between the membranes of the fetus and the mother's
Estrus synchronization

Recently, research has been directed to experimenting with ways of synchronizing and controlling estrus.

The procedure generally followed is to feed an estrous inhibiting substance, such as a progesterone-like compound. This compound is fed for about 15 days and then the inhibiting compound is removed from the ration. Within 4 or 5 days after the removal of the hormone, 70 to 90 percent of the females usually show estrus. Generally, the estrous period is normal and the cows are capable of conceiving.

Although these results seem promising, there are some problems to be solved before synchronization methods can be recommended for widespread practical use.

Reference Source: