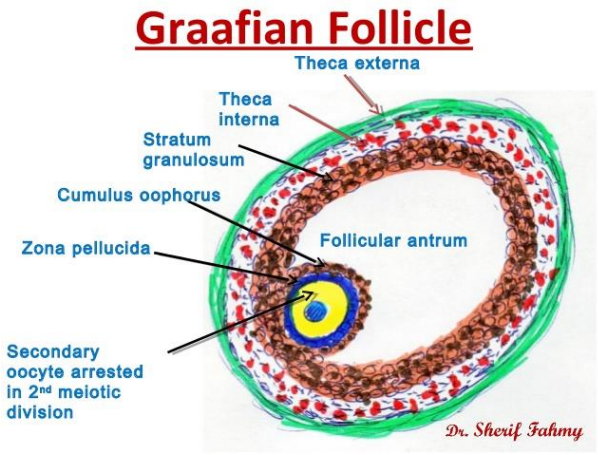
OVULATION

It is the physiological process in which 1 or more Graffian follicles rupture and release the oocyte along with cumulus cells.

In mature follicles just prior to ovulation, ova are usually seen surrounded by a halo of granulosa cells (cumulus) that are continuous with granulosa cells lining the fluid-filled antrum. The large, thin-walled follicles bulge from the ovarian surface.



SITE OF OVULATION:

► In buffalo, cattle, sheep and goat ovulation can occur at any place of ovary except attached border, as follicle can develop at any site.

► In mare ovulation only occurs at the **ovulation fossa**. **Why??**

Oocyte maturation:

The primary oocyte, which remains in an arrested stage of meiosis during follicular development, undergoes the first meiotic division to produce a secondary oocyte and the first polar body just before ovulation in most species.

Luteinizing Hormone Surge:

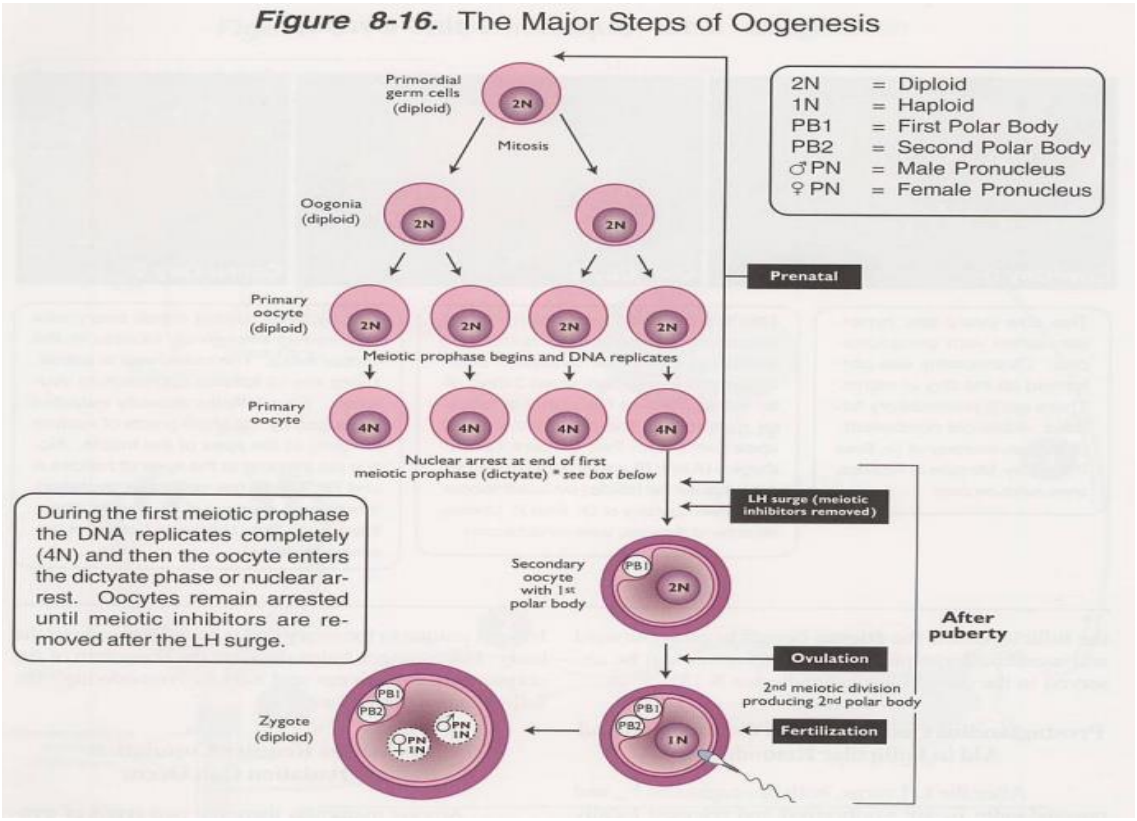
In most species, LH release from the adenohypophysis increases sevenfold to tenfold during the 24 hours prior to ovulation. After

reaching its peak, LH release rapidly decreases and plasma levels return to preovulatory levels. This short-term change in LH release is the LH surge which induced by the rapid rise in production of estrogens by large, mature follicles.

The extremely high levels of LH promote the final development of the primary oocyte and its progress though the first meiotic division. This prepares the oocyte for ovulation.

Granulosa cells also respond to the LH surge by transforming from estrogen-producing cells to progesterone-producing cells. This is part of luteinization, the transformation of granulosa cells to luteal cells (cells of a corpus luteum).

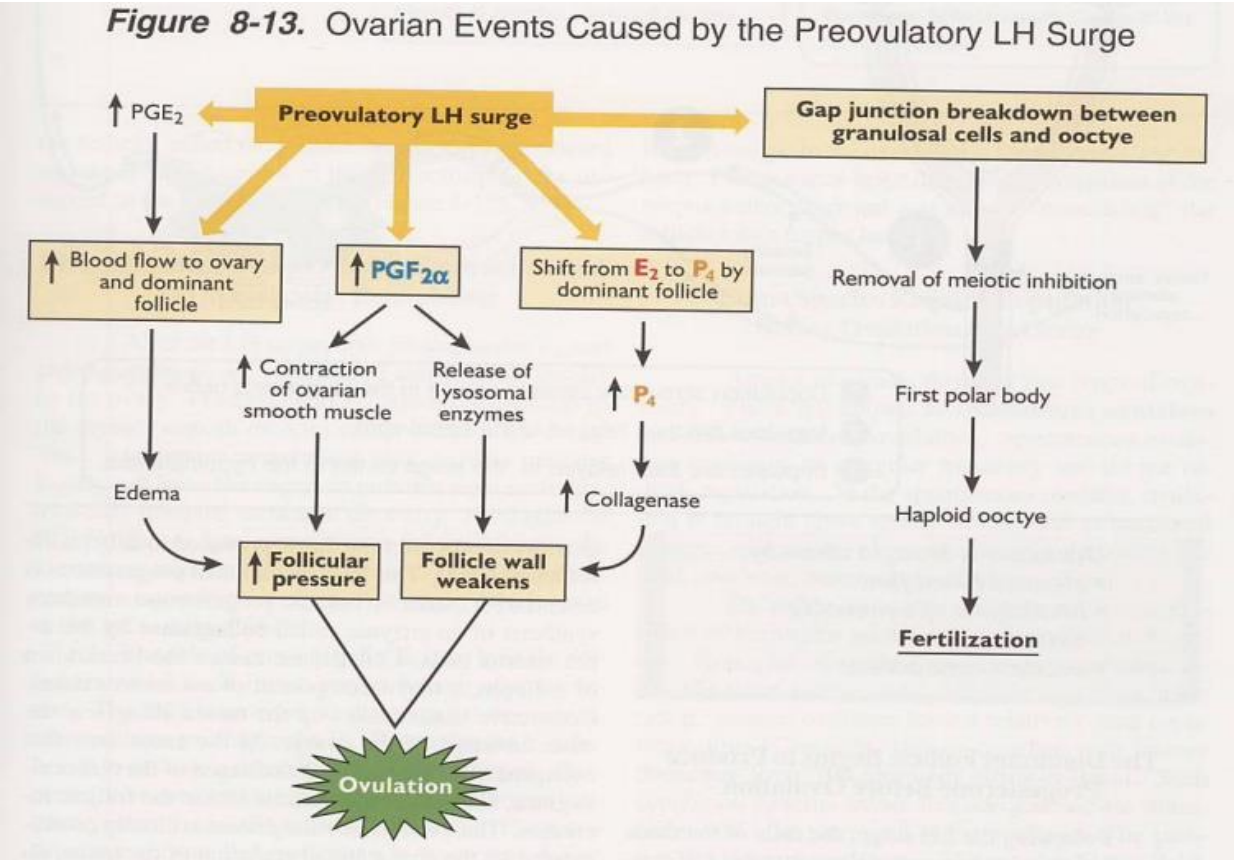
This process begins prior to ovulation, so estrogen levels are decreasing and progesterone levels are increasing at ovulation. Under the influence of the LH surge, granulosa cells also acquire the ability to synthesize prostaglandins, that will weaken the wall of the follicle and promote its rupture.



Type of ovulation:

The LH surge and ovulation occur in most domestic species (mare, cow, ewe, Doe and sow) independent of copulation, and these species are **spontaneous ovulates**. In these species, the preovulatory increase in estrogens from developing follicles is the primary event that brings about ovulation.

The female animals of some species (rabbit, ferret, mink, camel, llama, Queen and alpaca) usually require copulation for ovulation. These are **induced ovulates**. In these species, the final preovulatory surge of GnRH, and subsequent LH surge, is apparently dependent on a neural reflex elicited by vaginal stimulation. Induced ovulates animals have characteristic estrous cycles and follicular development, but mature follicles regress if copulation does not occur.



TIME OF OVULATION

Buffalo & Cattle: 12–15 hrs after the end of heat (heat period = 18 – 24 hrs)

Mare: 1 – 2 days before the end of heat.

Sheep & Goat: Just before the end of heat (heat period = 36 – 38 hrs)

Bitch: 1 – 3 days after the start of heat (Heat period = 9 days approx)

Camel & Cat: 24 – 36 hours after mating (coitus)

Luteolysis

The ovarian corpus luteum is a temporary endocrine organ with progesterone as its primary secretory product. A corpus luteum forms at the site of each ovulated follicle, so litter-bearing animals may have multiple corpora lutea on an individual ovary.

Corpus luteum formation:

Sometimes during ovulation small blood vessels rupture, and the cavity of the ruptured follicle fills with a blood clot**, a corpus hemorrhagicum**. The granulosa cells lining the empty follicular cavity begin to multiply under the influence of LH and form a corpus luteum, or yellow body. The granulosa cells also continue to undergo **luteinization**.

Corpus luteum degeneration:

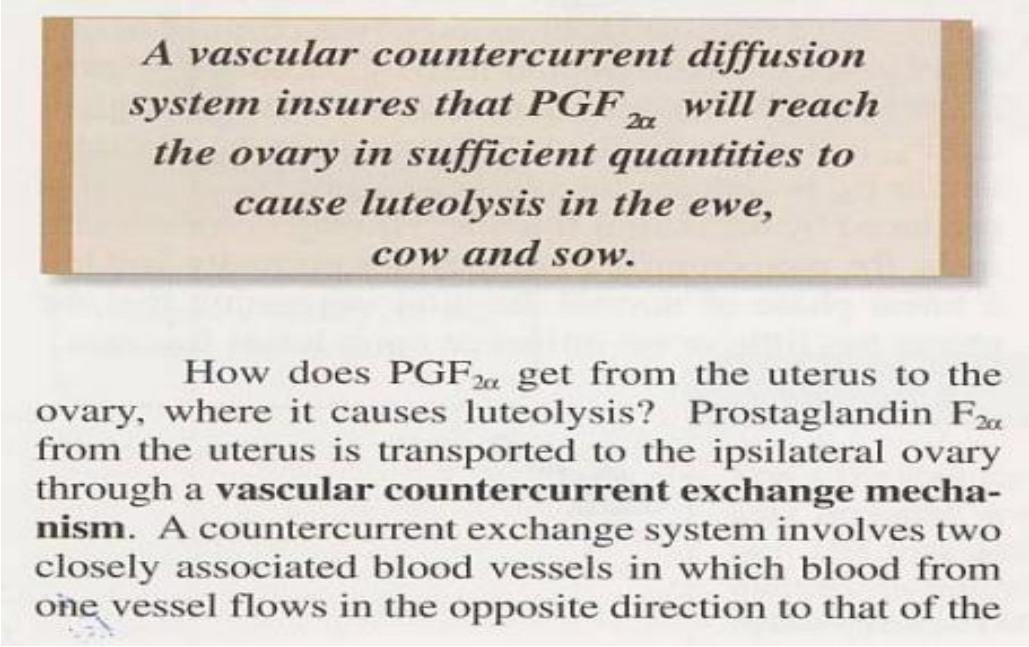
Blood progesterone levels increase as corpora lutea grow and develop after ovulation. When corpora lutea are fully developed, progesterone secretion is maximal and plasma levels stabilize. If fertilization of the ova does not occur and a pregnancy is not established, the corpora lutea spontaneously regress, with a relatively rapid decrease in plasma

progesterone. Corpus luteum regression entails apoptotic death of luteal cells, their removal, and the replacement of the corpus luteum with connective tissue forming **a corpus albicans**.

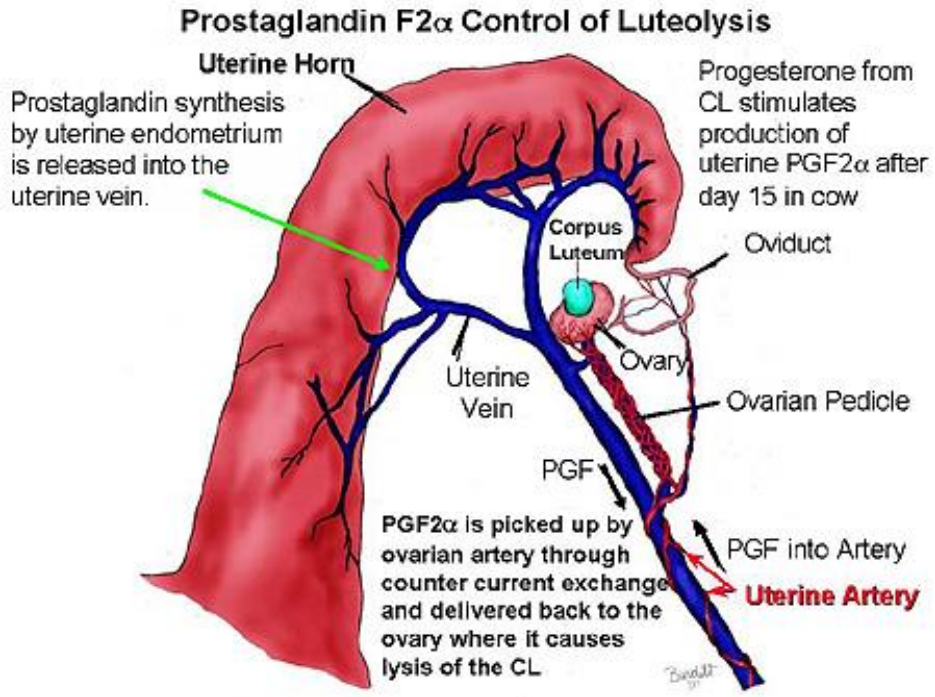
If a pregnancy is established, maternal recognition of pregnancy occurs, and regression of the corpus luteum is prevented. If a successful pregnancy is not established, the corpora lutea must undergo regression **(luteolysis)** to permit the animal to continue the estrous cycle.

Hormonal control of luteolysis:

The humoral signals between the uterus and ovary that initiate or inhibit luteolysis differ among species. In most domestic species (mare, cow, ewe, sow), prostaglandin F2α (PGF2α) is the humoral signal used by the nonpregnant uterus to stimulate luteolysis. The nonpregnant uterus increases PGF2α synthesis; releases are increased after ovulation at times appropriate for the species (e.g., 10 days for sows and 14 days for ewes); and luteolysis occurs shortly thereafter.



adjacent vessel. Low molecular weight substances in high concentrations in one vessel cross over into the adjacent vessel, where they are in low concentration. The $PGF_{2\alpha}$ produced by the endometrium enters the uterine vein and the uterine lymph vessels, where it is in relatively high concentration. The ovarian artery lies in close association with the utero-ovarian vein (See Figure 9-11). By countercurrent exchange, $PGF_{2\alpha}$ is transferred across the wall of the uterine vein into the blood of the ovarian artery by passive diffusion. This special anatomical relationship ensures that a high proportion of the $PGF_{2\alpha}$ produced by the uterus will be transported directly to the ovary and the corpus luteum without dilution in the systemic circulation. This mechanism is particularly important because much of $PGF_{2\alpha}$ is denatured during one circulatory pass through the pulmonary system in the ewe and the cow (around 90%). In the sow, only about 40% of the $PGF_{2\alpha}$ is denatured in the pulmonary circulation. By entering the ovarian artery, $PGF_{2\alpha}$ can exert its lytic effect directly on the corpus luteum before it enters the systemic circulation. The countercurrent diffusion system is present in the cow, sow and ewe, but not in the mare. The mare does not metabolize $PGF_{2\alpha}$ as rapidly as other species, so the need for a local transport specialization is not important in the mare. In addition, the mare CL is believed to be more sensitive to $PGF_{2\alpha}$ than the CL of the cow, sow and ewe.



Luteolysis: can be induced in cattle by administering analogs of PGF2a at any point in the estrous cycle as long as a corpus luteum is intact and functioning. The removal of the corpus luteum permits rapid development of new follicles and ovulation in about 3 days. The use of PGF2a to induce ovulation and estrus at a predictable time is a management tool to synchronize the estrus cycles of groups of animals.