



*Canine Breeder Excellence  
Seminar Track Summary,  
November 2022*

*By Sharon M. Albright,  
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# From CHF: Breeder Seminar Roundup

To provide breeders with current information specifically on reproduction topics that will help them achieve success in their breeding programs, the [AKC Canine Health Foundation](#) (CHF) and the [Theriogenology Foundation](#) (TF) sponsor Canine Breeder Excellence Seminars. Speakers are often graduates or mentors of the AKC/AKCCHF/TF Small Animal Theriogenology Residency Program—a

collaboration designed to increase the number of trained practitioners in companion-animal theriogenology and clinical genetics. Visit [akcchf.org/therio](https://akcchf.org/therio) to support and learn more about this program.

Here we summarize the presentations from November 2022.

To view a recording of each presentation, please visit the “Breeder Webinars” folder at [caninecollege.akc.org](https://caninecollege.akc.org).

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## CANINE PREGNANCY DIAGNOSIS AND C-SECTION STAGING

Presented by Natalie Orner, DVM

*Dr. Orner is a second-year theriogenology resident at the North Carolina State University College of Veterinary Medicine.*

As a review of the gestational phase of the canine estrous cycle (**Figure 7-4** below), Dr. Orner described the timeline of canine pregnancy. If the LH (luteinizing hormone) surge is day zero, the ovum develops during days 2–17, followed by embryo development during days 19–35, and finally fetal

birth (gestation length) in dogs is complicated because it depends on which day you start counting and because there is individual variation between the LH peak and when ovulation occurs. Some general guidelines are noted in **Table 1** below.

There are several methods useful to diagnose pregnancy in the dog:

### Palpation

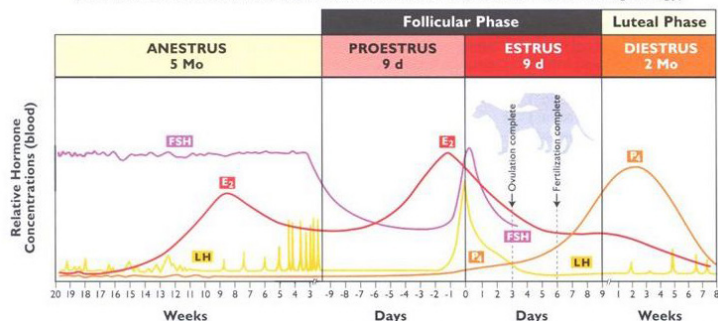
- From days 18–30, developing fetuses are palpable as 2-inch swellings in the abdomen and described as feeling like “pearls on a string.”
- From days 30–45, the bitch’s abdomen feels full, and it can be difficult to diagnose pregnancy.
- By days 45+, the fetal skeletons are easily palpable, and you may appreciate them moving within the bitch’s abdomen.

### Serum relaxin concentration

- Relaxin is a hormone produced by the placenta and specifically indicates pregnancy. However, it cannot distinguish between a viable pregnancy and a resorbed/resorbing

**Figure 7-4.** The Annual Reproductive Cycle of the Bitch

(Modified from Johnston, Root Kustritz and Olson. 2001. *Canine and Feline Theriogenology*)



development from day 35 to birth.

Determining the time from conception to

**Table 1: Canine Gestation Length**

Milestone	Whelping expected	Notes
Mating	57–72 days later	
Cytologic diestrus	57 days later (+/- 1 day)	This is a very accurate indicator if you have a microscope at home to monitor vaginal cytology.
LH surge	65 days later (+/- 1 day)	The LH surge correlates with a serum progesterone level of 2–2.5 ng/ml.



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litter, so ultrasound is still recommended to confirm live puppies.

## Ultrasound

- Amniotic vesicles are visible with ultrasound as early as day 20, but the best visibility occurs at approximately day 30.
- Ultrasound can determine gestational age and assess fetal viability.
- Ultrasound is not reliable for puppy counts.

## Abdominal Radiographs

- Fetal skeletons are reliably visible on abdominal radiographs by day 45+.
- For the most accurate puppy counts, radiographs are recommended at days 55–60.
- Radiographs are not a reliable method to assess fetal viability.

A cesarian-section (C-section) is the surgical procedure by which puppies are

delivered through an incision in the bitch's abdomen. A C-section may be required for a small litter when puppies are unlikely to produce enough hormone signals to stimulate natural birth, in brachycephalic breeds where the relatively large skull can obstruct the birth canal and which can also have inadequate hormone signaling, when the health of the fetal puppies is compromised, or in cases of dystocia or difficult birth.

During a typical active labor in the dog, it takes 20–60 minutes for each puppy to be produced, there are less than two hours between each puppy, and the entire process take 3–6 hours (or more depending on litter size).

Seek veterinary help when you notice any of the following:

- No puppy is produced after 30 minutes of hard contractions
- No puppy is produced within 30 minutes of a water breaking
- There are more than two hours between



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puppies being produced

- A total delivery time of more than 12 hours
- Any signs of pain or distress in the bitch
- Green vaginal discharge, but no puppy produced (an indicator of premature placental separation and that the puppy is not receiving adequate oxygen)

To help determine if a C-section is safe for the bitch and puppies, the veterinary team can measure the bitch's serum progesterone level to assess her readiness to support the puppies following birth. They can also use ultrasound to assess fetal kidney and gastrointestinal tract development and measure fetal heart rates which should be greater than 180–200 beats per minutes in late gestation.

Discuss C-section needs and plans with your veterinary team ahead of the bitch's

due date. Proper planning and understanding expectations will contribute to a successful outcome for all.

## BEST PRACTICES FOR TIMING CANINE CHILLED OR FROZEN BREEDINGS

Presented by Amber Nebel, DVM

*Dr. Nebel is a third-year theriogenology resident at the North Carolina State University College of Veterinary Medicine.*

Canine breeding management is defined as the process of using diagnostic tests such as serum progesterone concentrations and vaginal cytology to evaluate where a bitch is in the estrous cycle to optimize the timing of breeding and therefore fertility. A review of the canine estrous cycle (**Figure 7-4**, page 21) is always helpful. For breeding, we focus on the proestrus and estrus

**Table 2: Characteristics of Canine Proestrus and Estrus**

Proestrus	Estrus
<ul style="list-style-type: none"><li>■ Day 1 is indicated by vaginal bleeding and vulvar swelling caused by increasing estrogen</li><li>■ Ends with the LH surge</li><li>■ Vaginal cytology shows increasing numbers of cornified cells, red blood cells, and bacteria. White blood cells are normal at the beginning of proestrus</li><li>■ Serum progesterone is usually &lt; 2 ng/ml</li></ul>	<ul style="list-style-type: none"><li>■ Day 0 is the LH surge</li><li>■ This is the period of receptivity and fertilization</li><li>■ Vaginal cytology shows more than 85% of cells are cornified</li><li>■ Serum progesterone starts at 2–2.5 ng/ml during the LH surge, then increases to 4–10 ng/ml when ovulation occurs</li></ul>

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phases.

To time canine breeding, one must also understand the oocyte (egg cell) lifecycle. The canine LH surge takes about 24 hours. Ovulation starts 1–2 days after the LH surge

and lasts a full 24 hours. Dogs ovulate immature oocytes, which need an additional 1–2 days to mature before they can be fertilized. Therefore, the goal is to breed a bitch during her fertile window, approximately 4–6 days

**Table 3: Canine Semen Handling and Breeding Practices**

	<b>When to use</b>	<b>Important notes</b>	<b>Appropriate breeding methods</b>
<b>Fresh Semen</b>	Breed after ovulation has started.	Run multiple serum progesterone tests on the bitch to confirm ovulation (indicated by levels greater than 10–12 ng/ml).	<ul style="list-style-type: none"> <li>■ Natural cover</li> <li>■ Vaginal insemination</li> <li>■ Trans-cervical insemination</li> </ul>
<b>Chilled Semen</b>	Collect the male once the bitch’s serum progesterone level is greater than 10 ng/ml. Ship the sample and inseminate the female as soon as the chilled semen arrives.	<ul style="list-style-type: none"> <li>■ Chilled semen lasts 5–7 days in the female reproductive tract.</li> <li>■ It results in fertility rates similar to fresh semen.</li> <li>■ Recommend 2 breedings to maximize litter size</li> </ul>	<ul style="list-style-type: none"> <li>■ Vaginal insemination</li> <li>■ Trans-cervical insemination</li> </ul>
<b>Frozen Semen</b>	Inseminate the female 5–7 days after the LH surge when serum progesterone is usually greater than 20 ng/ml.	<ul style="list-style-type: none"> <li>■ Sperm damage occurs during the freeze/thaw process usually resulting in a loss of approximately half of the original sample.</li> <li>■ Thawed sperm only live for 8–12 hours in the female reproductive tract, resulting in smaller litters. approximately half of the original sample.</li> </ul>	<ul style="list-style-type: none"> <li>■ Trans-cervical insemination</li> <li>■ Surgical insemination</li> </ul>



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after the LH surge.

There are four common methods used to breed dogs: natural cover, vaginal insemination, trans-cervical insemination, and surgical insemination. Notes about which types of semen can be used for each method and the pros and cons of each semen type are summarized in **Table 3** (page 24).

### CANINE NEONATAL RESUSCITATION

Presented by Sara Lyle, DVM, Ph.D.,  
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*Dr. Lyle is board certified in theriogenology and is an associate professor of Theriogenology at North Carolina State University College of Veterinary Medicine.*

Neonatal puppies must be resuscitated

or revived after they are removed from the uterus during a cesarian section. It is ideal to have one person available per puppy, but if helpers are limited, do the best you can.

The steps to resuscitate a newly delivered puppy are:

1. Clear the airway (nostrils and mouth) using a suction bulb syringe. Do not swing the puppy as this can cause brain trauma.
2. Rub the puppy vigorously to stimulate breathing.
3. Provide supplemental heat with a warm towel or warming pad. The puppy can also be held in a warm water bath (keeping the puppy's head above water) while other resuscitation efforts are under way.
4. Provide supplemental oxygen with a small anesthetic mask or flow-by from a tube.

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The goal is to keep neonatal puppies warm and dry and keep their airways open. Mucous membranes should be pink with a capillary refill time of 1 to 2 seconds and their heart rate should be over 150 beats per minute. If the heart rate is low or absent, gentle chest compressions should be administered along with epinephrine given in the vein, bone marrow, or oral cavity. Use of the medication Doxepam is not recommended as evidence of its benefit is lacking. Puppies can ideally be housed in a heated and humidified oxygen cage until they are ready to go home.

Once revived, neonatal puppies may need nutritional support. Bottle feeding is not recommended, but care givers can be taught to tube feed the puppies. Neonatal puppies should ideally receive colostrum, the first milk that contains important antibodies and nutrients to stimulate the immune system. If the dam cannot provide colostrum, it should ideally be from a donor that lives in the same kennel or same geographic region, has recently been vaccinated, and demonstrated low sickness and high growth rates in previous litters.

Banked colostrum should *not* be thawed in the microwave, as this will destroy the protective proteins within it. If providing supplemental colostrum, give 1.5ml per 100 grams of puppy body weight. If colostrum is not available, canine plasma (the liquid part of blood) can be given through an

orogastric tube to provide some immunity. Again, a local donor should be used to ensure protection against relevant pathogens.

## COEFFICIENT OF INBREEDING: THE GOOD, THE BAD, AND THE UGLY!

Presented by Sara Lyle, DVM, Ph.D., DACT

*Dr. Lyle is board certified in theriogenology and is an associate professor of Theriogenology at North Carolina State University College of Veterinary Medicine.*

The coefficient of inbreeding (COI) is defined as the probability that two alleles of a gene at a randomly selected locus (location) are from the same ancestor. It is calculated with a mathematical equation, but there are numerous “calculators” available online to do the math for us.

- The AKC recommends a COI of less than 10 percent for a 10-generation pedigree, but notes that this is a generalization.

- The Institute of Canine Biology (ICB) recommends a COI of less than 5 percent and states that there is a significant loss of vitality and increased expression of deleterious recessive mutations when the COI reaches 10 percent.

- For comparison: mating half-siblings results in a COI of 12.5 percent and mating first cousins results in a COI of 6.25 percent.

COI is an indicator of pedigree relatedness,



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## Additional Resources

[Review of the Current State of Genetic Testing in Dogs from the AKC Canine Health Foundation](#)

[COI FAQs: Understanding the Coefficient of Inbreeding from the Institute of Canine Biology](#)

The webinars and more are available at [AKC Canine College](#).

but it gets confusing when the genome is examined. COI determined using pedigree analysis underestimates inbreeding compared to genetic analysis using SNPs (pronounced *snips* and known as a single nucleotide polymorphisms or germline substitutions of a single nucleotide at a

specific position in the genome).

This brief discussion of COI is provided to stimulate intentional thought about canine breeding programs. Even if fertility rates are good in a kennel, the breeder should still consider the COI and its implications for the long-term health of a breed. If a breeder is experiencing poor fertility rates, testing for genetic diversity should be considered. This is not the same as genetic testing for a specific disease. The reader is referred to the University of California, Davis, Veterinary Genetics Laboratory ([vgl.ucdavis.edu](http://vgl.ucdavis.edu)) for more information on this type of testing. **GZ**

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