

Part I

Breeding the Scottish Terrier: Planning, Preparation and Due Diligence

By Dr. Vandra L. Huber©¹

*The more you know,
The more you know you don't know
And the more you know you need to know*

To become a successful breeder, it requires extensive study of the breed standard, a fundamental understanding of genetics, extensive observation of the breed to determine desired type, mentoring by long term successful breeders, and the determination of preferences and trade-offs in conformation. In Part I of this two-part series, the precursors to whelping and raising Scottish Terrier puppies will be discussed. The focus will be on understanding the breed standard and deciding on type or line breeding and the importance of mentoring. In addition, the steps necessary to prepare for the eventual whelping of puppies will be explored. In Part II of the series (in the next issue of the Bagpiper), the rearing of healthy, well-adjusted Scottish Terrier puppies will be discussed. Table 1 summarizes the issues and concerns a Scottish Terrier owner needs to consider before breeding and during breeding.

Responsible breeders sell dogs and bitches that are not show potential, lack desirable qualities to carry on and/or are not better than their parents on spay/ neuter contracts. They keep only animals that are better than what they have or that overcome deficiencies in their line. If breeding is an option, then it is valuable to seek input from your mentor/breeder on what your bitch needs or what your stud dog has to offer. It is essential to have a mentor to bounce ideas off of and evaluate choices without prejudice. All too often, we are unaware of the great value that a knowledgeable individual can offer. Eventually, you will join a breeding family which consists of numerous people you trust. The AKC notes that when selecting a mentor, it's important to make certain that the chosen individual is truly breed-oriented, rather than kennel- or self-oriented. *"A breed-oriented individual will find good things to say about their competitors' dogs and dogs from other kennels and breeding programs, while a kennel- or self-oriented mentor will find goodness only in their own or associated bloodlines. Objectivity is a virtue of a good mentor."*²

¹ A version of this article was published in the Scottish Terrier Club of America's publication "The Bagpiper". Dr. Vandra L. Huber, McVan Scottish Terriers has been breeding and showing Scottish Terriers since 1982. Under the prefix McVan Scottish Terriers, she and her husband Michael Krolewski have bred more than 100 champions. McVan Scottish Terriers have been shown to No. 1 status in the United States, Australia, Singapore and Brazil. Additionally, they have been shown in Japan, Germany, Russia and England. She has bred the only American Scottish Terrier to go Best in Show at Crufts in England, Am. Can. Russ. Eng. Ch. McVan's To Russia with Love and owned Westminster Best in Show winner, Am. Can. Ch. Gaelforce Postscript. In her career as a breeder, Dr. Huber has dealt with her share of health issues (e.g.,, to name a few epilepsy, Scottie Cramp, Legg-Calves Perthes, liver shunt, fading puppies, stuck puppies, and c-sections).

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“First, you evaluate your bitch with brutal honesty. What are her strengths, what can you tolerate and what must you improve upon,” emphasizes Anita VanRavensway, LochRaven. Next, I look at pedigrees. Ideally, I would like something from my line on both sides of the pedigree.

Emphasizing that choosing a stud dog is hard work, VanRavensway attends the national and rotating and regional specialties to look for potential studs.

“You have to look beyond the sire’s picture directly and indirectly. Genes matter and the expression of those genes is important. I like to see if some attributes of the potential stud dog carry forward to the offspring. So I try to breed for type, line and needs. You’ve got to breed for it all. If you need a butt, you look at a sire’s offspring, not just the sire. If a stud throws nice rears with shelf for several different bitches (line bred and out-crossed as both are ideal), then you are more likely to get what you are hoping for.”

Cindy Cooke, Anstamm Kennel® concurs with VanRavensway. She begins by identifying the three things she would most like to improve on the bitch. Then she looks for a stud dog who has those three qualities, who has consistently produced them and who comes from a family of dogs that consistently share those three qualities.

“If I can't find a stud that has all three of those qualifications, then the dog’s production record takes priority. If he hasn't yet produced puppies, then I choose a dog that has the qualities and whose parents have the qualities. Unfortunately, it’s getting harder and harder to find good stud dogs just because our numbers have dropped so precipitately,” she states with some frustration.

As Kathi Brown, Blueberry, summarizes,

“It is in the balance of factors, the weighing of information that most consistently yields the best decisions. Certainly, we must have a correct mental image of our breed and the ability to judge specimens for breeding in relation to that picture. In this sense, a breeder is a “visionary” with the desire to improve each subsequent generation. We must also strive to obtain the necessary scientific knowledge on which we base our decisions.”³

Not only must you know your bitch’s strengths and weaknesses, you also must know your line and the health of the stud dog's line. It’s important to discern what may be lurking 1-3 or even more generations back. Dr. Amy Cada, Odyssey stresses, *“Healthy puppies start with healthy parents and grandparents. Ask the questions and get the answers. Insist on health testing (as complete as possible) for generations. There is no line without health issues – the question is, what was the response when one occurred.”*

“There is no perfection, but a stud dog should have multiple good traits that illustrate the Scottish Terrier standard. Health and longevity are essential to continue our breed. CHIC

³ Excerpted from Kathi Brown. September, 1990. Choosing the Right Stud Dog. American Kennel Club Gazette.

clearances and knowledge of health issues in the breed and in each stud dog's pedigree should help guide decisions for proposed breeding"

notes Deborah Brookes, Deblin. During her 40 years in Scottish Terriers, Brookes has had three ROMX stud dogs she has managed and people have used extensively. *"Temperament is often overlooked. A stable happy socialized dog without excessive sharpness or shyness often passes on these characteristics to his offspring Consistency and balance of these traits has always been the goal for my dogs and what I look for in the breed,"* she added, noting that when you have a stud dog with 111 champion pups as well as the other puppies, you definitely hear everything about the puppies – good, bad and speculation.

Breeding must go beyond looking at pedigrees, the popularity of recent champions and/or the closeness to a particular stud dog from one's home. At a minimum, a breeder must understand the basics of genetics including phenotype and genotype. The genotype is the descriptor of the *genome* which is the set of physical DNA molecules inherited from the organism's parents. Both parents contribute equally to a puppy. The phenotype is the descriptor of the *phenome*, the manifest physical properties of the organism, its physiology, morphology and behavior.⁴ Based on Mendel's principles, inheritance is particular and traits resegment upon further breeding rather than the thought that each parent contributes equally to the offspring and traits are blended.

All dogs transmit their genetic material on 78 chromosomes which are in 39 pairs. Shaking her head in amazement, Kathi Brown, Bluberry notes,

*"I am continuously amazed at the number of breeders who state something along the lines of, "Why not breed to the litter brother of the Champion Blackberry So-and-So; they have the same parents and, therefore the same genes?" She then emphasized, "Applying genetic principles, the probability that a sire or dam would produce two identical sperm or egg cells respectively is 549,755,813,888 to 1. In light of this calculation, it is clear that littermates carry different chromosomes, display different characteristics and transmit different genetic material to their subsequent offspring,"*⁵

It is important to examine the Coefficient of Inbreeding (COI). The higher the number, the more likely the genes will be expressed in the dogs. The first three generations matter the most. The farther back you go in a pedigree, the less likely the sire's or dam's genes will be expressed in the offspring. Half-brother or half-sister breedings should only be done by very experienced breeders. Positive versus negative genes are both likely to be expressed. This is because a tight line breeding doubles up on good as well as bad attributes. Line breedings may be necessary to determine the nature by which a specific gene is being expressed or if a dog or bitch is a carrier for an undesired genetic attribute.

⁴ Lewontin, Richard, Summer, 2011. "The Genotype/Phenotype Distinction", *The Stanford Encyclopedia of Philosophy* (Summer 2011 Edition), Edward N. Zalta (ed.), URL = <<http://plato.stanford.edu/archives/sum2011/entries/genotype-phenotype/>>. This is an easy to understand explanation of phenotype and genotype and Mendel's laws.

⁵ Excerpted from Kathi Brown , *September, 1990. Published in "Pure-Bred Dogs, The American Kennel Club Gazette.*

Following genotype and phenotype analysis, a decision needs to be made regarding when to breed. The American Kennel Club provides a wide breeding window. As noted in the Rules Applying to Registration and Discipline, *“No dog or litter out of a dam under eight (8) months or over twelve (12) years of age at time of mating, or by a sire under seven (7) months or over twelve (12) years of age at time of mating, will be registered unless the application for registration shall be accompanied by an affidavit or evidence which shall prove the fact to the satisfaction of The American Kennel Club.”*⁶

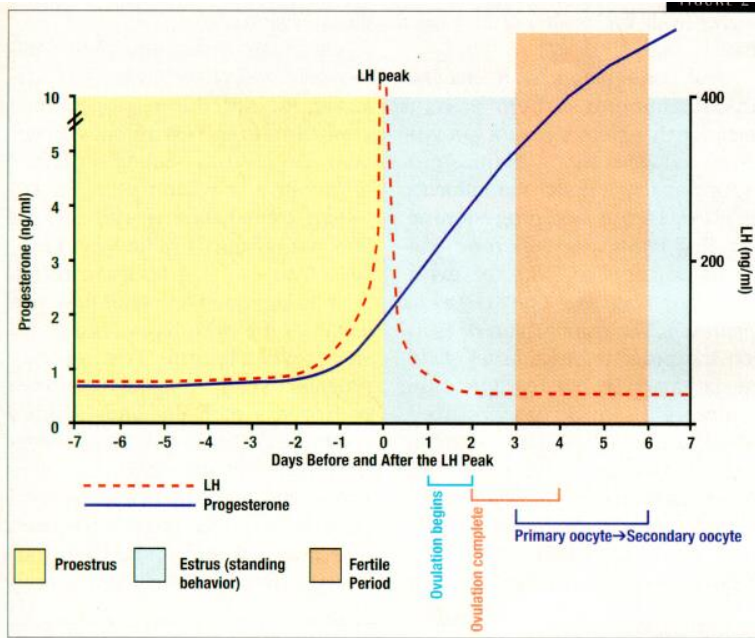
When the decision to breed has been made, the mating of two Scotties depends upon the readiness of the female. At the beginning of the heat cycle (proestrus), her vulva swells and eventually tips up, and blood is discharged. She will bleed for three to nine days. During this time, the uterus is growing a new lining for the embryo. When her bleeding subsides, she will be receptive to the stud and usually stands to breed (estrus). Standing heat can last three to seven days. This is the only part of her heat stage during which she can become pregnant. She alerts the male that she is ready by emitting a discharge with a distinct smell that can be sniffed for a long distance. *“I once made the mistake of letting a bitch ready to be bred out on my deck for an hour or so. Several coyotes came close to the house and we had a night of howling,”* Vandra Huber, McVan Scotties notes. After the seventh day of estrus, she will enter "metestrus," which will repel a stud's sexual advances. The bitch is most fertile 8 to 72 hours after ovulation. That is the window a breeder tries to hit.

The first indication that a bitch is coming into season is the swelling of the vulva which occurs up to seven days before bleeding begins. The potential dam may also lick herself more. When a bitch is ready to be bred, the vulva will tilt upward and be three times its normal size.⁷ Another commonly used indication is the "mating dance" between the male and the female and attempts by the male to mount the female. Standing heat leaves a wide window. Vaginal bleeding, swelling, "tail-turning" and receptivity to males is predominantly a response to estrogen in the bitch's bloodstream, but not a reliable indicator of progesterone levels and consequently, ovulation. Today, we have progesterone testing that predicts when ovulation occurs and when it's time to whelp the puppies (reverse progesterone test).

The use of physical indicators alone for breeding may not be a chance worth taking, especially with valuable semen according to Dr. Marcia Dawson, HiJinks. The Chairwoman of the STCA's Health Trust continued that while the hormone estrogen stimulates the ovaries into producing eggs, it is the hormone progesterone that rises as the heat cycle progresses and that maintains a pregnancy. Early in the heat cycle the progesterone values will usually read less than 1.0 ng/ml. The first significant, sustained rise in progesterone usually coincides with the "luteinizing hormone" (LH) surge. The progesterone value at the time of the LH surge is usually about 2-3 ng/ml. LH is released by the pituitary gland in the brain. Ovulation occurs about 48 hours after the LH surge, at @ 5 ng/ml. Then it

⁶ Excerpted from. Rules Applying to Registration and Discipline: Also applies to Foundation Stock Service January 1, 2016. Chapter 3: Registration. American Kennel Club: p 6.

⁷ Excerpted from Dog Reproduction (The Heat Cycle): Signs of Heat. Accessed from <http://www.dogbreedinfo.com/breedingheat.htm>



2. The physiologic and behavioral events during the canine estrous cycle and their relationship to the fertile period.

takes another two days for a bitch's eggs to mature. Once mature, the eggs remain fertile for 2 to 3 days and then deteriorate. The idea is to maximize contact time between viable semen and fertile eggs. This requires a brief discussion on semen longevity. At the time of insemination, the progesterone can be in the teens and into the 20's (ng/ml) or higher. Progesterone stays elevated for about 2 months whether the bitch is pregnant or not.⁸ Then it drops when it's time to whelp the puppies begin to Ovulation can occur as early as day 7 and as late as day 27 of the estrus cycle, emphasizing the importance of the progesterone test

. For ovulation purposes, a breeder is only interested in the day when the bitch exceeds 5 ng. Vaginal bleeding, swelling, "flagging," and receptivity to males is predominantly a response to estrogen in the bitch's bloodstream, and not a reliable indicator of progesterone and consequently ovulation. Second, a bitch may or may not be receptive at the proper times. Like humans, the dog and bitch may not like one another and may display aggression towards the potential mate. Most importantly, **whelping always occurs 63 days after ovulation**. So, by using progesterone tests, you can easily calculate the whelping, regardless of when or how many times the bitch is inseminated, Dawson concluded.

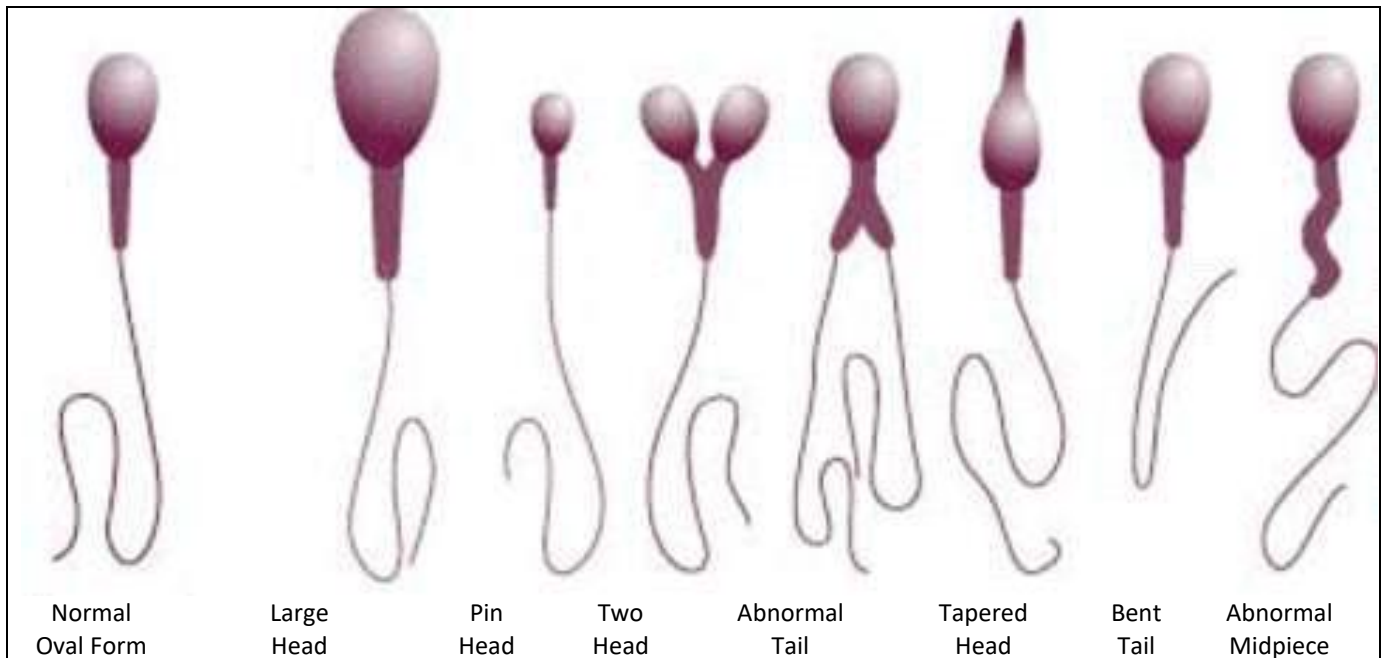
Larae Shafer, Chyscott, notes that the advent of progesterone testing has definitely streamlined the breeding process. Rather than breeding multiple times over several days, she relies on the test to indicate when to breed. *"I do two days before and two days after the progesterone surge and that's that."*

Regarding breeding options, research on natural and artificial insemination indicates that breeding should occur as follows:

- Natural breeding should occur 3 days after the 2.5 ng/ml mark. Sperm in fresh semen survive 5-7 days after insemination.
- Artificial insemination using fresh chilled semen should be used for a 1-time breeding. Insemination should take place 4 days after the progesterone reaches the 2.5 ng/ml mark or 48 hours after the 5 ng/ml mark. Sperm in chilled semen survive 48-72 hours after insemination. With artificial

⁸ _____ .2016. Progesterone Testing and Ovulation Timing in Dogs. Canine Semen Bank of Columbus. http://caninesemenbank.com/Progesterone_Testing.html

insemination, the semen should be deposited into the cervix to increase the chance of it being drawn into the uterus.



Artificial insemination using frozen semen should be performed 5 days following the 2.5 ng/ml mark or 72 hours after the 5 ng/ml mark. Sperm in frozen semen survives less than 24 hours after insemination. Frozen semen is ideally deposited directly into the uterus through surgery to increase the chance of pregnancy.¹² The more invasive the AI technique, the greater the likelihood of trauma and injury to the bitch.¹³ There are also practical reasons for Artificial Insemination (AI) versus a natural breeding. These include such things as:

- The male and female do not get along, so you can avert a dog fight.
- Performance anxiety of a young male can be averted.
- It takes less time to AI rather than assist with a natural breeding.
- A sire not normally available (frozen semen from a deceased dog, dogs from other countries), can be utilized
- Frozen or fresh-extended semen can be used.
- Protection and continuous evaluation of the stud dog's semen is available.
- A stud dog with a physical disability can be used.
- Size incompatibility of the dog and the bitch (i.e. height) can be overcome.
- An ejaculation can be split between two or more bitches.

¹² Dr. Race Foster and Dr. Marty Smith. Hormone Levels: Determining Breeding Times and Whelping Dates. Accessed from: http://www.peteducation.com/general.cfm?static_pagesid=5

¹³ Royal College of Veterinary Surgeons (RCVS), 2005: Advice Note 8 – Canine Surgical Artificial Insemination. RCVS, London as cited in GCW England and KM Millar. 2008. The ethics and role of Fresh and Frozen Semen in Dogs. Domestic Animal 43 (Suppl. 2), 165–171

- Infections are less likely to be transmitted.

Vaginal restriction or persistent hymen can be dealt with easier via the AI. Disadvantages include causing physical or psychological trauma during the AI process, undertaking AI for inappropriate reasons (e.g. where reluctance to breed is a manifestation of underlying hereditary disease such as hip dysplasia or anatomical abnormality of the reproductive tract), potential for introduction of heritable diseases or abnormalities, allowing overuse of a male within a breeding program and, possibly allowing confusion of parentage if puppies are not subsequently tested.¹⁴ Frozen semen requires storage and the assistance of a reproduction veterinarian to impregnate the bitch.

Metrics For Canine Sperm¹

Parameter	Normal Values
Ejaculate volume (without prostatic fraction)	1-6 ml
Sperm concentration	100-500 million/ml
Total sperm per ejaculate	300-2000 million
Progressive motility	Greater than 70%
Morphology	Greater than 80% normal

1. Melissa Rogue. Semen Collection from Dogs
<http://www.vivo.colostate.edu/hbooks/pathphys/reprod/semeneval/dog.html>

There is no evidence that a natural tie is more effective than artificial insemination for impregnating a bitch. Published studies convincingly indicate that all semen preparations – fresh, fresh-extended or frozen – will produce larger litters if semen is deposited directly into the uterus. Other research shows fresh dog-to-dog insemination gives the best semen preparation. Fresh-extended or “chilled” semen has performed very well for many years, but not as well, statistically, as fresh semen collected at the time and on the same premises as the breeding. The worst statistics are for frozen semen. Many intervening variables (freezing, shipping, thawing, time, broken vials, shipping delays, etc.) can affect the efficacy of frozen semen.

Despite the science, many breeders still prefer a natural breeding or natural tie. Ethicists concur, noting that a natural breeding more likely respects the wellbeing of the bitch. Dogs, like other animals, may prefer a specific mate or shun another. AI's may have a positive ethical impact (e.g., for disease control or preservation of genetic material), but positives don't usually outweigh potential risks. Ethically, the decision to do AI's only is made to protect the dog from infection from a bitch and from injury by a bitch. During the tie, the dog may be injured if the bitch throws herself about. Aggressive bitches may damage a dog's libido.¹⁵ According to animal ethicists, an AI intervention is predicated upon four conditions: (1) a sequential decision-making process has ruled out a natural mating; (2) there is informed choice on the part of the breeder and owner; (3) information sharing proceeds rather than follows the breeding, and (4) an informed consent provision is part of the stud dog contract. The contract should be clear regarding the mechanism to be used to breed the two Scotties, whether the semen sample is to be split and used on more than one bitch simultaneously, and who will be responsible for the costs associated with the breeding method.

¹⁴ GCW England¹ and KM Millar, 2008. The Ethics and Role of AI with Fresh and Frozen Semen in Dogs. *Reproduction of Domestic Animals*. 43 (Suppl. 2), pp. 165–171.

¹⁵ Dr. Mary Wakeman. 2002. Artificial Insemination. *Breeder Vet*. Excerpted from Show Dog Super Site at <http://showdogsupersite.com/kenclub/breedvet>

Some individuals will stick with natural breedings and others will rely upon their veterinarian to conduct an AI. Elizabeth Warfield, Warscot, is a certified veterinarian assistant. She notes that a breeder can learn to conduct an AI using fresh semen. Insemination kits can be purchased from such sources as Myra Savant or Drs. Fosters and Smith. Alternatively, a breeder may create her own kit. Needed is a plastic sandwich bag without a zip lock, an unused 12-30 ml syringe and a sterile 14 French catheter(purchased from a medial supply house). Michael Krolewski, McVan, notes,.

“We let the dog and bitch flirt first on the floor. We put a rug for footing on our kitchen counter or a grooming table. While I hold the stud dog’s rear feet to keep him from moving, my wife, Vandra, gets the dog aroused. Once the dog is aroused, she holds the dog’s penis behind the bulbous glandis, (e.g. an erectile tissue structure on the penis of the dog). This swollen structure normally would lock the penis into the vagina. Grabbing tight behind this circular muscle with one’s hand, she uses her other hand to place a baggie over the end of the penis to capture the ejaculated sperm and prostatic fluid. After enough fluid has been acquired (5-8 cc), the semen can be sucked up into a syringe via the catheter tubing. The catheter tubing has already been cut to be slightly longer than the distance from the vulva to the uterus”¹⁶

Once the semen is collected Krolewski sits in a comfortable armchair with a towel over the chair arm and another over his front., The bitch is held with her feet in the air at least a 45° angle. Her rear feet are over the arm of the person and the armchair. Because the catheter tubing is flexible, it can be inserted relatively easy via the vulva into the vagina. Using the syringe, the semen is then inserted slowly. Finally, the tubing is then gently pulled back out. Vandra quickly places her thumb in the vulva to serve as a stopper holding the sperm in somewhat like a bulbous glandis would do in a tie. Now free, the right hand can be used to massage, move the rear legs of the female to help move the sperm forward, and to feel contractions. The downward position of the bitch is continued for 20 minutes. Then the bitch is placed in a crate for 2-4 hours and activity is minimized

It’s important to note that abnormalities in the vagina and uterus may prevent the breeding from working. Vaginal malformations are recognized as altered anatomy which can be due to congenital anomalies such as an imperforate hymen (where the hymen is solid, not allowing fluids through the vaginal canal from the uterus, or normal penetration [such as for breeding]; generally a congenital anomaly); dorsoventral septum (or septae, where the vagina has a vertical dividing membranous wall/partition); hymenal tightening; cysts (a sac with liquid inside); or to acquired conditions, such as vaginal overgrowth, foreign bodies, strictures (tightenings), adhesions (abnormal fibrous tissue sticking to the structures), and cancer.¹⁷ Strictures in the vagina may prevent the catheter from going into the uterus. Scar tissue from past C-sections and cysts also are problematic.

¹⁶ See for example: Michael Krolewski. Artificial Insemination of a Scottish Terrier at Home. McVanScotties.com. Accessed on Oct 15, 2016 at http://mcvanscotties.com/Articles/pdfs/AlofScottishTerrierFinished2008_1.pdf.

¹⁷ _____ Vaginal Abnormalities in Dogs. Accessed on October, 21, 2016 at http://www.petmd.com/dog/conditions/reproductive/c_dg_vagin

According to Brian Greenfeld, DVM, an associate in the reproduction practice headed by Robert Hutchinson, DVM.,

“Fresh semen can remain fertile in the bitch’s uterus for 3-5 days and in some cases even longer, depending on quality. Fresh chilled semen, because of energy lost in the cooling and subsequent warming process, may live only 24-48 hours in the uterus. Frozen semen, due to the stress of the freezing process and energy lost, may live only 12-24 hours in the uterus. Clearly, the shorter the sperm’s life span, the more paramount it becomes to know when it should be inseminated to allow for maximum contact time with fertile eggs. In the case of fresh semen, there is more flexibility for these reasons.”¹⁸

According to Krissy Simmons, Chyscott’s, their Reproduction Veterinarian says that a broad spectrum antibiotic such as Clavamox should be given from the time the female comes into season through 30 days. This helps ensure that the environment in which the eggs and sperm are is healthy. It’s important to check with your veterinarian as not all antibiotics are safe for bitches in whelp. Additionally, the Chyscott team worms bitches every two weeks. Both actions are preventive to provide safe harbor for the fetus, to prevent absorption of puppies, and to maintain a healthy uterus for the embryos.

In place of a broad spectrum antibiotic (e.g., Clavamox or Cephalexin) and worming, Jeanice Barton, Haslemere, recommends conducting a Culture & Sensitivity test on a bitch’s uterus **prior** to breeding. Cells from inside the uterus are needed to conduct the 2-part test. A very lengthy, guarded swab is inserted by your veterinarian through the vagina, up to the uterus. The guard swab then opens to capture some of the flora inside the uterus. The culture part of the test is conducted first. It tells you that something is may to be growing in the uterus. If bacteria grows from this culture, it is then identified via the sensitivity portion of the test..

The sensitivity test involves determining what bacteria is growing in the culture, if any. The bacteria are subjected to a variety of antibiotics known to usually kill the bacteria identified in the culture step. This all takes place in a single Petri dish with antibiotic sensitivity discs. In a few days, the dish is examined for zones of inhibition. The size of the area of dead bacteria around the antibiotic disc tells which antibiotics are working and how well. *“This enables your vet to determine which antibiotics will kill the bacterial infection in your bitch...and which will not.”*

“I decided to do the Culture & Sensitivity test on one of my bitches shortly before I bred her. She was in seemingly perfect health, happy, energetic, bright-eyed and showing zero outward signs of any type of illness. I was simply curious. The culture came back to show that she had an extremely high amount of E. coli living and reproducing within her uterus. I was stunned. An E. coli filled womb was not the place I wanted little puppy fetuses growing for 9 weeks,” Jeanice explained.

“I had previously had fading puppies from this bitch in prior litters. Coincidence? Who knows,” she continued. *“Some animals live happily and unaffected with their own bacteria. Others do*

¹⁸ Brian E. Greenfield. Progesterone Testing - A Successful Breeder. Accessed on October 18, 2016 at <http://www.gundogsonline.com/Article/Dog-Progesterone-Test-Page1.htm>

not. Introducing various bacteria to newborn puppies with undeveloped immune systems or puppies who are weak at birth is a different story. Without having this test done, I would have never known there was an issue. I often wonder how many bitches were harboring dangerous levels of bacteria in their uterus at the time of breeding that later resulted in pyometra or caused mysterious, and needless, puppy losses after whelping.” she added.

One potential problem that can occur is resorption according to veterinarian Tracy Powell, DVM. It is defined as early embryonic or fetal death within the first 45 days of pregnancy. When a resorption occurs in a bitch, you do not usually see anything externally. There are no contractions and nothing is seen when a fetus passes. The bitch essentially dissolves the fetus inside of her. Most scientific studies say about 10-15% of fetuses are resorbed. That means at least 1 in 10 fetuses are resorbed. At an extreme, all puppies can be resorbed in a single litter.¹⁹

Resorptions occur because of infectious and noninfectious causes. Infectious causes include bacteria, parasites and viruses. Some bacterial organisms that cause resorption include *Brucella canis*, *Campylobacter*, *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus spp.*, *Salmonella*, Canine herpesvirus, Canine distemper virus, and Canine adenovirus (infectious hepatitis). Some parasites include *Toxoplasma gondii* and *Neospora caninum*. One of the most important causes is maternal environmental stresses. The author likes to ship her bitches early so the bitch can settle in. She also prefers that the bitch stay for a week after the final breeding. This is done to minimize biological and social stressors.²⁰

The work does not end when the bitch is inseminated. It is extremely important to prepare the prospective Scottie dam for babies. According to Reproductive Specialist Jessica Wilcox, DVM, Evergreen Veterinary Clinic, nutrition plays a big role. Rather than regular dog food, the bitch should be given puppy food which offers greater nutritional value. As whelping gets closer, the amount of food also should increase to provide nutrition to the rapidly growing puppies.

“The malnourishment of bitches before breeding and during pregnancy is a major factor in neonatal puppy mortality, which is estimated to be between 20 and 30 percent. Just like growth and performance, reproduction is a physiologic state with nutritional requirements that exceed those of a maintenance phase. A bitch who is pregnant or has just given birth draws upon the nutritional reserves deposited in her body before and during pregnancy. A malnourished female will not have sufficient protein, vitamins, minerals and energy to support pregnancy,”²¹

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¹⁹ Tracy Powell, DVM. Resorption. Great Dane Review. Accessed on October 15, 2016 at <http://greatdanereview.com/pdfs/Resorption.pdf>

²⁰ Canine Abortion by Jeanette L. Floss and David K. Hardin. University of Missouri Extension Office, College of Veterinary Medicine at the University of Missouri. Excerpted from <http://extension.missouri.edu/p/G9931>

²¹ Stephen Smith, May 4, 2015. The Care and Feeding of the Breeding Bitch –Part 1. Published by the American Kennel Club. Accessed at <http://www.akc.org/content/dog-breeding/articles/the-care-and-feeding-of-the-breeding-bitch-part-one/> on 10.15.2016.

American Kennel Club research indicates that food should be highly digestible and palatable. It should contain at least 29 percent protein and 17 percent fat. High amounts of soluble carbohydrates and a low fiber content are also important to ensure adequate energy intake and to avoid hypoglycemia (low blood sugar) in late pregnancy. Adequate intake of calcium (between 1 and 1.8 percent) and phosphorous (between .8 and 1.6 percent) intake helps with milk production by the bitch so that the pups' bones form properly.

Kathleen Hefner, DVM adds that too often breeders overdo it on the calcium. If some calcium is good, more is better. *"Feeding excessive amounts of calcium, TUMS or vitamin D can cause calcification of the soft tissues of the fetus, as well as other birth defects. While lactation requires large amounts of calcium, supplementation during pregnancy does not prevent calcium depletion during lactation (eclampsia) and may actually compound the problem. Second, meat product supplements may decrease the carbohydrate content of the diet and can be associated with hypoglycemia and stillbirths,"*²² she emphasized.

If you want to know early in the pregnancy whether you are having puppies or not, there are a few options. Abdominal palpations have been used for years to confirm pregnancy. Palpations require an experienced individual who knows what to feel for AND a dog willing to relax enough to confirm the pregnancy. Deep bodied dogs like Scotties do not make the task easy and require a higher level of skill. Other more direct methods are usual better options.

An ultrasound performed by your veterinarian is a more accurate, safe, and non-invasive method to determine pregnancy. It's conducted around the 28th day of pregnancy. During an ultrasound exam, high-frequency sound waves are directed to a specific area -- in your dog's case, her abdomen -- where they're transmitted through, reflected or absorbed by the tissues they encounter. The reflected waves return to the probe as an echo and are converted to an image, resulting in a two-dimensional picture of the area being examined. Depending on the skill of the operator, an ultrasound will confirm the viability of puppies and may be able to tell if resorption has occurred. Determining the number of puppies depends upon the expertise of the ultrasound technician or veterinarian (see Table 2 for average prices for tests).

A second option is a new hormone test, Relaxin, which can diagnose pregnancy or a false pregnancy as early as 21 days after breeding. The blood test does have a high false negative rate (e.g. incorrectly predicts a bitch is not pregnant). Thus, more than one Relaxin test maybe be needed to determine pregnancy. Relaxin is sold in kits of five (\$110/kit) so repeat testing can occur. The kit measures relaxin levels in plasma and serum samples. The presence of significant amounts of this hormone is a reliable indicator of pregnancy. Relaxin can be detected in biological samples soon after implantation of the fertilized egg, which occurs about 22-27 days after mating (26-31 days post-LH surge).²³If you are willing to wait, you may see physical changes that occur (e.g., growth in uterine area girth, nipples

²² Ibid. Stephen Smith,

²³ Canine Pregnancy Test. Accessed at <http://www.bullwrinkle.com/ShoppingPages/dog-pregnancy-test-canine.html>. Also see Betty Lewis. What can Ultrasound Tell You About Pregnant Dogs. The Daily Puppy. Accessed at <http://dogcare.dailyuppy.com/can-ultrasound-detect-pregnant-dogs-6207.html>

clearing, throwing up). A radiographic x-rays can confirm pregnancy, but you must wait until the eighth week of pregnancy.

Rod Ott and wife Pilar Kuhn, Bravo, are practical and just do an x-ray 10 or ~~less~~ fewer days before the due date. The X-ray can delineate the skulls and spines of the puppies. when the skulls of the puppies are formed. If there is a large number of puppies, an x-ray may fail to detect all the puppies. Ott who comes from a farming background states that it's more practical and fiscally prudent to wait and do one X-ray. His wife counters that the ambiguity of waiting is difficult to deal with. *"I still want to know for planning purposes, but I'm learning to wait,"* adds Kuhn.



Picture curtesy Happy Trails Havanese at www.dogbreedinfo.com/whelpingphotos.htm

In the last weeks before the puppies are due, it is valuable to set up a quiet stable area for your

bitch to have her puppies and allowing only her into the area so she is familiar with it. Building or buying a whelping box is essential.²⁴ About a week before whelping is due, most breeders start taking the temperature of their bitch. When the temperature drops below 100 to about 98 degrees, whelping is thought to be imminent. Unfortunately, there are often false alarms. A more accurate test is a "reverse" progesterone test. About 48 hours before whelping, the progesterone level drops to the 2 ng/ml range and within about 24 hours of whelping, the level drops to the 1 ng/ml range. This can help determine the proper timing of a c-section, especially if the progesterone level or LH level were not used to determine the ovulation date. Ott and Kuhn use the reverse tests as whelping insurance. If the test indicates progesterone is low, below 2 ng/ml, they will go ahead with a C section. *"It's also helped us from spending long nights at an emergency clinic with a veterinarian we didn't know. It fills in important information and has helped us whelp more live puppies that are full term and healthy,"* Kuhn stressed.

Part 2 of the article will discuss the birth of puppies. It will also address birth defects, the question of "are we helping too much?", and the difficult decision of when to put a puppy to sleep. Finally, it will offer tips on raising healthy, well-adjusted puppies.

²⁴ See McVanScotties.com for an innovative whelping box design that allows puppies to breath even when under the pig rail in the whelping box. Magna whelping boxes as Revival Animal Health, Dura Whelp at <http://www.breederbase.com/>