

## ***SHOULD I BREED MY DOG?***

You may be wondering whether or not you should breed your dog. Here is some information. The summary is that if you want to do it right, and get healthy and happy puppies, it is very expensive and a lot of work.

Remember that you are going to need a vet that is familiar with whelping dogs. This will be your best resource, as well as any long-time breeders that you know. Not all vets are knowledgeable about whelping so be sure to ask around and especially look for recommendations from local breeders that you may know.

### ***I want to make some money!***

Breeding, and doing it right, is an expensive undertaking. By the time you've picked out a good bitch, waited for her to grow old enough (minimum age: two years before breeding), picked out the best dog to mate her with, gone through all the health checks she needs (hips, elbows, heart and eyes), ensured that the dog you want to use also passes the same health checks, you've invested a lot of time and effort. You still have to pay a stud fee (or give a puppy back), you have potential extra expenses during pregnancy, you have the time and expense of whelping (either you take time off from work or something goes wrong and you have to take her in to the vets). You need to keep the puppies for a minimum of 8 weeks before sending them to their homes; you need to advertise and find good homes for the puppies, you need to make sure they have had their shots before going. You may have possible vet bills if the puppies require extra attention. If some of the puppies die, or you have a smaller than usual litter, you may not get as much money from the sale of the puppies as you had thought. There are even potential problems later on with dissatisfied customers! You are better off consulting with a financial wizard about investing the money you would otherwise spend and lose on breeding!

**Breeders frequently count themselves *lucky* if they break even.**

### ***My kids should see the wonders of birth and life!***

What if the whelping goes wrong and dead puppies are born? What if the bitch dies? These are all very real risks that you are undertaking. Much better alternatives include videotapes that are available. If there are local 4-H clubs, those provide alternatives for children.

Or, you could contact your local shelter and see if there is a pregnant bitch about to whelp or a litter of puppies that need to be raised and socialized before being adopted out. This would allow you to find out just what this could entail, while helping the shelters rather than potentially contributing to the problem.

### ***I want another dog just like mine!***

If you want to breed your dog so as to get another dog like yours, think about this for a moment. No matter how special your dog is to you, a puppy out of it is not guaranteed to be just like or even similar to your dog -- half its genes will be from another dog! You will have to find another dog that also has the characteristics you want in your puppy; that dog will have to be unneutered; and the owner of that dog will have to be willing to breed her/his dog to yours. It is much easier, often less expensive, and certainly less time consuming to pick out an existing dog that you like from the shelter or another breeder. Best yet, go back to the same breeder of your dog, if possible, and pick another puppy out of similar lines.

### ***Every bitch should have a litter!***

This is flat out wrong. Bitches are not improved by having puppies. They may undergo *temporary* temperament changes, but once the puppies are gone, she'll be back to her old self. Nor is it somehow good for her physically. In fact, you will put her at risk of mammary cancer and pyometra. There is absolutely nothing wrong with spaying a bitch without her having a litter.

### ***But my dog is registered!***

Well, yes, but that doesn't *mean* a whole lot. A registered dog, be it AKC, UKC, CKC, etc., simply means that it's parents (and their parents) are also registered with the same registry. This confers no merit in of itself; it simply means that the dog's parentage is known.

Most registries do not make any assertions of quality in the dogs they register (except for some limited breed-only registrations, but these are uncommon). They do not restrict the breeding of their dogs and hence there is no guarantee that a registered dog is a good specimen of its breed.

The AKC has just started a "limited registration" program whereby puppies out of such dogs are ineligible for registration. It remains to be seen what the overall impact on AKC dog breeds will be. Other registries have used similar programs with good results.

### ***So I should breed when...?***

The *only* reason you should be breeding is that you honestly feel that you are improving your breed by doing so. There are far too many dogs in the country to breed without good reason. A dog in a breeding program must be one whose genetic history you or its breeder is intimately familiar with. Such a dog must represent the best efforts of its breeder at that point. Such a dog must have good points to contribute, whether that is in good conformation, good performance or whatever. Such a dog must have some evidence of external evaluation. That is, others besides the breeder or the owner must also think that the dog is a good representative of its breed. That usually translates into titles, whether for conformation, obedience, field, herding, or whatever is appropriate for that breed. Such a dog must be tested as it matures for any problems that tend to appear in its breed, whether that is hip dysplasia, patellar luxation, von Willebrand's, cataracts, PRA, fanconi syndrome, subaortic stenosis, etc.

### ***Potential Hereditary Problems***

Every breed has a different set of potential problems for it. I have listed common ones below, but this is not to say that all dogs must be checked for everything listed. You need to do research in your breed to find out what the common problems are. You will also need to research the particular bloodlines you are using to see if they are prone to any additional problems you want to know about and screen for as well.

### ***Eyes***

Most breeds require eye checks of some sort, for a variety of problems. These include, but are not limited to problems such as

- Progressive Retinal Atrophy (PRA). This disease eventually causes total blindness. In some breeds the onset is quick, before the dog is two or three. In others, the onset is much later, when the dog is four to eight years old (and may have already been bred). Irish Setters have a test available that can detect carriers and affected dogs; other breeds do not have this recourse. It appears to be a simple autosomal recessive, but the late onset complicates breeding programs. If a dog is affected, then both parents are either carriers or also affected.
- Retinal Dysplasia. Causes eventual blindness. This is believed to be hereditary. Some dogs can be detected with this condition in puppy hood, but carriers cannot be identified until they produce such puppies.
- Collie Eye Anomaly (CEA). This affects the collie breeds (bearded, border, rough, smooth) as well as some closely related ones. This condition has varying degrees of severity from hardly affected to blind; the problem is that this disease is inherited and two hardly affected dogs may easily produce a severely affected dog.
- Cataracts. There are many forms and causes for cataracts, but some forms, such as juvenile cataracts, are inherited and such dogs should not be bred.
- Entropion, Ectropion: These are conditions in which the eyelids turn in or out, causing various problems and often pain for the dog.

The Canine Eye Registry Foundation (CERF) in the USA registers dogs that are found to be clear of eye problems by a board certified (AVCO) veterinarian. Dogs need to be cleared yearly as there are some types of eye problems that show up later in life.

### ***Hip and joints***

There are a variety of joint problems found in most breeds. Toy breeds can have joint problems too; just because your breed is smaller doesn't mean you can figure you are free of hip dysplasia and be done with it. There are several problems that specifically affect smaller dogs!

- Hip dysplasia is probably the best known problem. This is a malformation or deterioration of the hip joint, so that the socket it sits in is too shallow to secure the head of the femur. As the condition progresses, arthritic changes

begin to destroy the protective cartilage and the dog may experience severe pain if the condition is bad enough. Some dogs are asymptomatic, but still should not be bred. This condition primarily affects the medium-to-large breeds, but smaller breeds have been known to be affected, for example Cocker Spaniels and Shetland Sheepdogs can have this problem. To make sure your dog is free of hip dysplasia, you need to have the hips radiographed and then obtain an expert analysis of the xrays. Your vet isn't necessarily the one to do this! In the US, you would mail the xrays to the Orthopedic Foundation of Animals and wait several weeks for their evaluation. In Canada, Europe and Britain, there are equivalent programs, but all differ in the type of certification and age at which they will certify; some organizations certify after one year of age, others certify after two years of age.

- Osteochondrosis Dessicans (OCD) is an elbow joint problem. A bone spur or a flake wears away at the joint which becomes stiff and painful. Xray evaluations of these joints are also needed. Many breeds that are prone to hip dysplasia may also have OCD.
- Patellar Luxation is a problem affecting the kneecaps. Smaller dogs are more prone to this problem than larger ones are. The kneecap will slide out of place and lock the leg straight. Diagnosis is fairly straightforward and surgery can correct the problem, but no dog with patellar luxation should be bred as this is also an hereditary condition.

There are a few other types of problems, affecting other joints like the hocks, or affecting the spine, that you should be aware of in some breeds. This is only an overview to give you an idea of what kinds of problems are out there. Remember that joint problems, even if not hereditary, may make it problematic for a bitch to be bred. Pregnancy is hard on the joints and on the body in general and if she isn't in the best of physical health, it is much kinder not to breed her.

### ***Other things to check for***

- In some breeds, deafness is a potential problem. Puppies at risk should be BAER tested and any that fail should be neutered.
- *Heart conditions* in many breeds must be checked for. Subaortic stenosis (SAS), other malformations of the heart or valves.
- Hemophilia type of problems, e.g., von Willebrand's disease and others.
- Malabsorptive syndromes, digestive problems.
- Epilepsy.
- Allergies.
- Incorrect temperament for breed.

Finally, remember that not only the potential dam *but also the sire* must be checked for all the things appropriate for their breed and particular bloodlines.

### ***Medical Checks before Breeding***

You must make sure the bitch and the stud both are free from brucellosis before breeding them. Brucellosis causes eventual sterility in both sexes (sometimes non-obviously) and can cause a litter of puppies to be aborted or die shortly after birth. In addition, brucellosis is on occasion transmissible to humans via the urine or feces of an affected dog. Between dogs, it is most commonly passed in sexual intercourse, although an entire kennel can be infected through contact with secretions.

The sire should be in excellent general health. The dam *must* be in good health, to withstand the stresses and rigors of a pregnancy. They must both be up to date on their vaccinations.

### ***Temperament***

Never breed any animal that has temperament problems. In particular, this has been the cause of the degeneration of many breed's general temperament: Doberman Pinschers, Rottweilers, and so on. If your animal is untrustworthy around people, overly aggressive to people, excitable, or is a fear-biter, do not breed it. If it is shy or submissive, don't breed it. Look for happy, confident and obedient animals, and consider carefully the particular temperament requirements for your dog's breed.

There are a variety of tests to indicate a dog's temperament. Many of the working breeds have a temperament test (for example, the Doberman's WAC test) for their breed. AKC has a Canine Good Citizen test (open to all dogs) that gives some indication of the dog's temperament (and, yes, training). Therapy Dogs International and other Therapy Dog clubs

have temperament testing that does try to separate out actual temperament from training. Obedience titles can be (but are not necessarily) an indication of good temperament.

## **Pedigree Research**

You must carefully consider each dog's pedigree for compatibility. Try to select strengths to offset weaknesses. Do not allow your bitch to be bred to an unsuitable dog, and conversely, be picky about the bitches you allow your dog to breed. This phase alone requires considerable research to find a suitable candidate, and you should definitely work closely with a knowledgeable person, ideally the breeder of your dog. Simply because two dogs "look good" or even *\*are\** good does not mean that they necessarily complement each other: suppose they are both carriers for the same disease? Suppose they both have a tendency to overbites or other disqualifying faults?

Be honest with yourself. If your dog is not a good representation of its breed, do not let it reproduce. It is much easier to improve a few faults than to try and get excellent pups with a mediocre dog. Check the breed standard for your dog and ask a knowledgeable person for their evaluation of your dog.

More on the importance of scrutinizing a pedigree in the genetics section below.

## ***Frequency of Breeding***

Ideally, a bitch should only be bred every other year and she should not be bred much before two years of age (Rottweilers should never be bred before they are two and have cleared all their health certifications). The season closest to the second birthday is a good one to start with; certainly no earlier than this. In some breeds, you may need to wait one more season before beginning. By this time, she is better prepared mentally for having puppies than she would have been with her first few seasons. Her physical growth is complete and pregnancy at this point won't endanger her health, provided that she is healthy to begin with.

In breeds with Hip Dysplasia, many people wait until after two years of age so that the parents can be certified; however if you have sent in xrays to OFA for preliminary evaluation and they came back as fine, many breeders consider it safe enough to then breed on the season closest to the second year, which can wind up being before the bitch is actually old enough to be certified. (And when the bitch is old enough, she is, of course, duly certified.) But the preliminary xrays *must* be examined by OFA, not by a local veterinarian. There are many dysplastic dogs out there that had vets look at their xrays and pronounce them "wonderful."

For dogs, they should definitely have all their certifications necessary. For many breeds this means that they should be over two years old. Since a dog can be bred at any time, unlike bitches, waiting for two years is not a problem, whereas a bitch often has a season just before two years of age and then has to wait until 2.5 or three which sometimes presents problems in trying to time her litters. But this does not apply to a stud dog, so he should definitely have all of his checks and certifications before being bred. Frequency is not generally a problem although some dogs have problems with sperm production if they breed once a day for several days. They need top-quality feeding and care if they are going to be bred often.

## ***Care of the Pregnant or Nursing Bitch***

You should make sure the bitch is up-to-date on all her vaccinations, medications, and shots before she is bred. She will require supplementary food during the last three weeks or so of pregnancy. In general, puppy food is formulated both for puppies and pregnant or nursing bitches.

She should be under the care of a vet for any related problems. Dogs can have miscarriages. Illnesses, diseases, or infestations that the bitch picks up during her pregnancy can affect the puppies. Difficulties during whelping are entirely possible, and the rule for some breeds. You must be prepared to get her to the vet quickly in an emergency.

There are instances of "mummy puppies" where you have a puppy whose development went awry, but it was not aborted. Instead, it dries and shrivels up, and when born, looks like a mummified puppy, blackened and ready to rot. Over-breeding and inadequate care are usually the causes. It is quite likely that the dam will come down with an infected uterus after such a puppy. "Water puppies" are another type of problem in which the dead puppy appears to have never properly developed a skeleton and appears to be full of gelatin. This seems to be linked to a viral exposure.

Other congenital (but not genetic) defects can include: no anus, cleft palates and hare lips. These conditions require corrective surgery or the puppy will die.

While the bitch is nursing the puppies, she will require about three times the amount of food she normally eats! It is also common for nursing mothers to go out of coat at this time.

### ***Caring for the Puppies***

#### ***Prewhelping preparations***

You should have a sturdy, clean, proper sized whelping box for the litter. It MUST include a "pig rail" around the edge to prevent the bitch from laying on or smashing her pups. It should be big enough to allow the bitch to turn around but small enough to prevent the pups from being "lost" in the unused portions. About six inches longer than she is, fore and aft, when laying prone (as in suckling her puppies) and about a foot on either side length wise.

To get the whelping box ready for your bitch, get a sheet of plastic, such as you would use for painting a ceiling to protect the floor. Cut it up into several pieces the size of the whelping box. Put one piece of plastic down, several layers of newspaper, another piece of plastic, more layers of newspaper and so on for four or five layers. Then when your bitch is whelping puppies, you can roll off a layer when it gets messy -- and it will! -- and throw it away to instantly clean the whelping box.

#### ***Postwhelping***

After the puppies are born, there are many strategies for lining the whelping box. Some people continue to use newspapers, but puppies get pretty dirty from both newspaper print and feces. Other people have had success with synthetic materials on top of absorbent materials: the synthetic material provides secure footing, but the urine and other liquids pass through it to leave it dry. Other people use pine shavings (about six inches deep). You will do a lot of laundering to keep things clean no matter what you use. You will also have to clean the feces out of the whelping box after your bitch decides that's no longer her job.

Newborn puppies MUST be kept warm. The temperature in the whelping box at birth should be at least 75 - 85F. The temperature can then be decreased 2 degrees every other day after the puppies are two weeks of age. NEVER FEED A CHILLED PUPPY!!! If a puppy becomes chilled it will cry continually. A healthy, happy, litter will "purr" like a swarm of bees. Warm any chilled puppy by putting the puppy under your shirt and under your armpit. The best method of warming a puppy is to use a special whelping box heating pad with a towel over it to prevent soiling the pad. Make sure the temperature does not go too high. Heating lamps are ok but puppies can become dehydrated. If the litter clumps together and cries, they are too cold; if they separate and try to hide under shade, they are too hot.

Large litters will require supplemental feedings if you want all the puppies to survive. Your bitch may not be able to care for a very large litter. You will need to get the pups rotating on shifts. For the first two weeks you may have to supplement as much as every four hours. Use a good prepared milk-supplement especially formulated for puppies. If you get in a bind you can use a goat-milk recipe available in most books about breeding and whelping pups. You may have to tube feed those pups that will not suckle from a bottle!

Are you going to remove the dewclaws or dock a tail? This must be done by 3 days old at the latest! Any later will not heal as nicely or quickly!

If you have a purebred litter, you must record the date of birth and all of the pups (including the dead ones) in your record book. Then you will need to fill out and send in your litter registration form. You want to do this as soon as possible, since many registries can take up to 6 weeks to return the forms for individual registration to you (which you will want to give to your puppy buyers later).

You will have to keep the whelping box clean. For the first two weeks the bitch will keep the pups pretty clean, but the bedding should be changed twice a day at minimum. Starting week three, the pups start to eliminate some on their own.. then you will need to clean much more often!

At four weeks, the pups usually become very active and at this time may require a larger area than the whelping box...you will need a large ex-pen or some way of confining them safely. You do have a place to keep them that they are safe in and can't destroy? Puppies at this stage can devastate a room or garage in hours.

Around week four you will probably want to introduce the pups to weaning food. Usually you will have to mush up the dry puppy food for the pups to be able to eat it. Use warm water and let the food stand in a bowl for about 2 hours.

At week six you should vaccinate and worm the pups, and have them checked for heart murmurs, hernias, males for testicles (yes you should be able to feel them at 6 weeks!), deafness, and eye problems.

You should be socializing now too... And are you going to do any puppy testing for temperaments? At seven weeks you should be calling up those people with deposits on your pups and getting your paper work all sorted out. Are your spay/neuter contracts ready? How about pictures of the pups for your clients?

And this is just if everything goes perfectly! What happens if one of the pups has a heart murmur, or a hernia? What about a deaf puppy? What if your whole litter gets parvo or distemper? What happens if one of the pups is affected with "swimmer-puppy" syndrome? What about fading-puppy syndrome? What happens if your bitch gets an infection or mastitis? What if she dies?

### ***Placing the puppies***

After the puppies are born, if not before, you must consider placing your puppies. Time and time again, people breed a litter because friends and family want one of their dog's puppies -- and then none of them will take one.

At six weeks is when even seasoned breeders wonder why they do this. A healthy active litter of six will run you ragged at this age. They are so curious, they want to explore everywhere, and they are at the prime age for socialization and exposure to many things that you, as a responsible breeder, want to give them a head start on.

At eight weeks, you may begin placing those pups that are ready to go to their new homes. Insecure pups may need more time, how are those puppy tests coming? You can't place puppies earlier than 7.5 weeks or so (no matter how much you may want to).

Are you prepared to do some legwork to find GOOD homes for them, not just hand them off to the first person who comes by? You are aware that you won't always be able to sell all of your puppies locally, aren't you? What assurances do you have that the puppies will not wind up filling animal shelters, facing death because their parents were thoughtlessly bred? Suppose you wind up keeping more of the litter than you intended to? Suppose some of your puppies are returned? Can you keep the extra puppies?

### ***Considerations for Stud Dogs***

First, remember that it is extremely difficult to come up with a top quality stud dog that people want to use. After all, they will look around and pick out the best male they can find. So your dog has to be pretty impressive to be noticed in the competition.

Your male should be in top condition. He should be certified clear of joint problems (and in many cases that means he has to be at least two years old). His eyes should be checked annually. He should be clear of any abnormalities common to his breed. No heart problems, no seizures, no thyroid problems, etc. He should be clear of brucellosis. His temperament should be good, and appropriate for his breed. If you have such a dog, you will need to get your dog well known. This generally involves showing your dog (in show, field, or obedience) and doing other work with him. An unproven dog (that has no previous puppies or only puppies too young to evaluate) will command a much lower stud dog fee than a proven dog (with a record of puppies to examine).

You must be prepared to board the bitch. The common procedure is for the bitch to be shipped out to stud, so you will need facilities to board bitches in heat. These facilities should be adequate for up to a week of boarding and to prevent any mismating. You might wind up with more than one bitch at a time -- can you board them all safely?

You must monitor the mating and be ready to intervene if necessary. Some breeds require intervention (such as Basset Hounds). Not all dogs or bitches understand what to do, especially if it is the first time for one or the other. It can be disastrous if two dogs are left alone to mate. Additionally, if the mating doesn't take, are you prepared to go through the whole thing again the next time the bitch comes into season? Typical contracts call for free repeat breeding in the case two or less puppies occur or the breeding doesn't take.

You need to be able to evaluate the bitch's pedigree for compatibility with your dog's. Any good points or bad points of the litter are (rightly or not) attributed to the sire, so your dog's reputation is at stake with each litter he sires. You should be reasonably confident that the proposed breeding will result in good puppies.

If the owner of the bitch is a novice, are you prepared to assist with advice on whelping and puppy care? These people will expect you to have the answers. Sometimes entire litters of puppies are dumped on the stud dog owner when the bitch's owners can no longer cope with them because they didn't realize what a responsibility caring for a litter involved. Are you ready to take care of and place your dog's offspring if this should happen to you?

Are you prepared to deal with cases where you are certain your dog is not the sire of the puppies but the bitch's owner insists that he is? Or if the owner of the bitch insists that you must have allowed a mismating to occur when she was boarded with you? Disputes of this sort can become very ugly very quickly.

## **Genetics**

*If a purebred dog of breed X mated with a purebred dog of breed Y, both meeting health standards for their breed, is there a better chance the offspring would be healthier than a same breed mating because the gene pool is larger?*

In terms of health alone the first answer would be that in breeding two healthy dogs it shouldn't matter if they're the same of different breeds, you're apt to get healthy pups. But this doesn't take into account the question of recessives. Suppose you breed two dogs of different breeds that both have the same incidence of a recessive health problem. The pups would have the same odds of having that health problem as purebred pups of either breed. On the other hand, suppose the two dogs were of breeds that have no recessive health problems in common. This would reduce or eliminate the odds of the puppies of having the health problems of either breed. This is the classic explanation for the theory of first generation hybrid vigor. The resulting pups should not be bred though, since they'd have a good chance of having the recessives from BOTH breeds, so the grandpups would be inclined to be worse off than the purebred offspring of their grandparents. An excellent set of articles dealing with "hybrid vigor" can be found in *DogWorld*, Jan 1997 by George Padgett DVM. Another *very* important point to keep in mind is that when a purebred carrying a genetic defect is crossed with another breed or mixed breed, the "bad" genes do NOT "go away" even though they may not be expressed in the offspring. If crossed with another dog carrying the same defect, the offspring of that breeding *will* demonstrate the defect. *Purebred dogs have all these diseases, though! It seems that you never hear about mixed breed dogs with problems.*

Responsible breeders try to identify genetic diseases their dogs might be carrying and to eliminate them by careful breeding. It is ironic, though not surprising, that their efforts to identify and weed out genetic problems have lead some to cry "look at all the genetic diseases purebred dogs have!" A moment's careful thought will lead you to the conclusion that mixed breeds carry the *same* harmful genes (their parents, or their parents' parents, *were* purebreds, after all). The differences are

- with some recessive disorders (though not *all* genetic defects) the disease is less likely to be *expressed* (though it can still be inherited by offspring)
- you have lesser likelihood of ever identifying or eliminating any harmful genes your mixed breed may be carrying

Also, if you stop and think about it, many mixed breeds are simply not tested for most problems. When they get older and limp, it's just considered old age, although it could well be hip dysplasia. When they get older and start to go blind, it could be PRA, but the owners are unlikely to test for this. It's not that owners of mixed breeds are bad, by any means, but they are not looking for possible inheritable problems, either.

*When you breed two different breeds together, what kind of variation can you expect?*

Pfaffenberger's book has some interesting data on this. He did some experiments with four different breeds. They were dogs of approximately the same size, but very different physical appearance AND behavior. The results he saw in the first and in subsequent mixed generations are pretty interesting.

Let's look at a common crossbreeding: "cockapoos" (which are *not* purebred dogs, nor registered with any registry). These are crosses between Cocker Spaniels and Miniature or Toy Poodles. The dogs actually vary quite a bit, some being more poodle like than others, and some being more cocker like than others. However, they are generally all a small sized, buff colored shaggy dog. If you breed two cockapoos together (not generally done), you get an even wider variation of dogs -- some look like Miniature Poodles, others like Cocker Spaniels. The reason for this is the recessive genes hidden in the first cross that came out in the second generation. This is actually a visual example of why "hybrid vigor" doesn't hold.

## ***What is outcrossing?***

Outcrossing is where the sire and dam are totally unrelated, preferably for three or four generations. The true form of an outcross is between two entirely different breeds because in reality the members of most registered breeds come from a common ancestor (although it may be many, many generations back). It is very rare for outcrossed puppies to be uniform in appearance. Usually there are a very large range of sizes, coats, colors, markings, and other distinctive characteristics. Outcrossed litters are generally heterozygous, and do not reliably reproduce themselves, so even the nicest puppy in the litter may not later produce the best puppies.

Outcrossing is generally used to introduce something new to a line -- a better head, better colors, better front, etc. Usually the puppies retained from these breedings are bred back into the breeder's original line to standardize them back into the line's general characteristics and reproducibility -- with the one desired characteristic. The tricky part is that other characteristics may come along for the ride!

If you are dedicated enough, you can eventually continue breeding by outcrossing alone (but don't expect instant or quick results). You should pick dogs that complement each other well and are similar in general appearance. This is a long hard road to eventually developing a line. Through outcrossing, many health problems can quickly be eliminated (or just as quickly added into your breeding), but usually you do sacrifice some show quality and producibility.

You have to remember that dogs that appear totally healthy may be carriers of genetic problems. To find this out, test mating is done to a dog that is affected with the genetic problem (resulting usually in puppies that are both affected and non-affected carriers) or by inbreeding to a related dog that also doesn't show the signs of being affected (usually littermates are used) this will usually result in some puppies free of the problem, some puppies as carriers, and some puppies affected if both dogs carry the problem gene (this is not as accurate as breeding to an affected dog, but you are less likely to have to put all the puppies down).

There are variations on outcrossing. A "true" outcross could be a dog that has totally unrelated dogs bred together throughout the pedigree. This is very rare. On the other hand, "linecrossing" is a form of outcrossing where dogs from unrelated lines are bred to produce a new line. The sire and dam are usually very linebred from their prospective lines and the resulting puppies are varied in appearance, some looking like the sire's line and some looking like the dam's line and some looking like mixtures of both lines.

## ***How about line breeding?***

Line breeding is when the sire and the dam are distantly related: e.g., grandsire to granddaughter, granddam to grandson, second cousins, half cousins, uncle to niece, aunt to nephew..... The general strategy is that there is a common ancestor that is being doubled up on both sides. So the desired dog appears several times in the pedigree.

This is probably the most common strategy in breeding purebred dogs (and in developing new breeds, for that matter). Though this method, new genes are slowly introduced and unwanted genes are slowly replaced. The actual rate varies by how strongly you line breed. It sacrifices little overall quality in terms of show quality. Usually the puppies are rather close in general conformation. The only problem with this method is that it often takes several generations to get poor genes out, (or adding desired genes in) resulting in many puppies that have the same genetic problems (or virtues) that their parents have. And then because some breeders are more interested in winning, they do not place the affected puppies on spay/neuter contracts. This is both a blessing and a curse for the breed. If the breeder is very careful, affected pups can be used wisely to prevent loss of quality, but still remove the affected genes by only breeding the affected pups to known non-carrier relatives. This way the breeder can again try to "edit out" the bad genes. It takes longer this way but less show quality is lost in the process. This process results in dogs that will often reproduce their same level of quality. This is referred to as reaching homozygous litters (more genes of the same kind apparent in the puppies).

Inbreeding and linebreeding really differ only in degree. Linebreeding is less likely to cause harm than inbreeding. Inbreeding is not for novices. Knowledge of genetics and the breed is required for success. For good results it must be well-planned and breeders must be ready for whatever problems it presents.

## ***And inbreeding?***

Inbreeding is where the sire and the dam are closely related: mother to son, father to daughter, sister to brother, half sister to half brother, cousin to cousin. People disagree about the exact point at which inbreeding becomes linebreeding. Inbreeding is the quickest way to find out what poor genes are in the line and what dominant characteristics are in the line.



Although many people are disgusted with the idea of this family incest, it is an extremely useful tool for diagnosing what genes are present. If the genes for bad eyes are present, but hidden or recessive, this will bring them out to their full extent. If there isn't any bad genes, then the puppies will be of very close uniformity and very able to reproduce themselves (theoretically). This is a homozygous breeding. The resulting puppies will have a lot of genetic material that is the same as their parents and grandparents and will be close genetically to each other.

Inbreeding doesn't introduce new genes and does not eliminate bad genes that the line already has. It only shifts them around like a rubix cube. This often results in litters with high show potential, if the quality was high to begin with. It shows you what recessives you have lurking in the dogs' backgrounds -- *both* good and bad. But there are drawbacks. Besides the possibility of bad recessives, inbreeding exclusively will eventually lead to infertility. It's like a xerox machine. After so many copies, you have to renew the ink. The same with dogs, you have to introduce new genes. No reputable breeder will use inbreeding exclusively, and many breeders simply never use it. Usually, you will only find: very experienced breeders, ignorant breeders, and puppy mills making use of this technique.

Inbreeding increases the chance that a gene obtained from the sire will match one obtained from the dam, both stemming from the common ancestor(s) on which the individual was inbred. Thus, inbreeding tends to make animals homozygous rather than heterozygous. The inbreeding coefficient measures the resulting increase in homozygosity. All breeds have a given degree of homozygosity the mating of two dogs from the same breed would not produce a recognizable specimen of the breed!

Inbreeding increases homozygosity and decrease heterozygosity. So it can duplicate both desirable and harmful alleles, both of which can be unsuspected in the line, and may appear. Inbreeding does NOT create anomalies, it brings present anomalies to the surface. Even when the anomalies are present, inbreeding might not reveal them. However, once revealed, then the breeder can do something about them in the next generations of breeding.

An increase in harmful recessives is undesirable but it is not a major drawback if they are identified early. The effect of inbreeding on major polygenic traits is greater. Generally, traits that are highly inherited (ie largely additively controlled) are not adversely affected by inbreeding but, traits under non-additive control, especially those tied to dominance and thus not of high heritability, are often markedly harmed by inbreeding.

### ***OK, how do pedigrees figure into this?***

Remember that it is difficult to spot unaffected carriers. When an affected dog shows up, its pedigree is often examined for likely carriers. For example, PRA is a common problem in many breeds. There are dogs that come down with PRA that have a certain ancestor in common. That ancestor may then be considered a possible carrier and line breeding on him is avoided. This is a simplistic picture, obviously, since it's possible for an unaffected non-carrier of PRA to come from an unaffected carrier that came from an affected dog (therefore the affected dog is in the unaffected dog's pedigree). If a general blood test is ever developed that shows the presence of the recessive in an unaffected dog, then much more accurate breedings may be done; currently this is only possible for Irish Setters.

There is rarely only a single problem a breeder is trying to screen for. Suppose a suspected carrier of PRA is known for producing excellent hips. A breeder might therefore introduce that bloodline into theirs for the hips, and be willing to have the possibility of PRA show up in the line. In screening out one problem you might have to accept the possibility of another appearing.

Examining the pedigrees also lets you know what percent of ancestry the dogs share (since the relationships are often much more complex than simply cousins or aunt/uncle, the degree of common ancestry is often given as a percentage instead) and decide whether or not it's acceptable given your current goals.

### ***What are like-to-like matings and compensatory matings?***

Like to like mating implies the best to the best and the worst to the worst where the worst is not used at all. For most breeders, like to like matings are between dogs which resemble each other greatly and so similar type dogs are bred. These dogs may or may not be closely related.

The pups resemble their parents because of the genes in common with them. If those parents resembled each other their progeny would be even more like their parents. This tends to make the population look more uniform, however there is little increase in prepotency from this technique.

Compensatory Mating: This unlike to unlike mating is used by breeders to correct for a defect in an animal by mating it to another animal that might correct for the defect. The system is basically simple but the breeder must identify faults and virtues and it requires breed knowledge. The pedigrees of both dogs should be examined carefully to try to identify the ways in which the dogs differ and what the expected outcomes could be. A correct dog and not one who errs in the opposite direction is required. That is, if you want to improve structure, look for a dog with correct structure and not an overbuilt dog. This technique often results in only one or two pups with the combination desired.

***But this is all very vague and complicated!***

Yes, it is. There are no easy answers, and there are different things to consider in every breed. This uncertainty with respect to genetic inheritance is exactly the reason that breeding is so difficult to do right. It helps immensely to have a "mentor", someone who is familiar not only with the breeds, but the lines your dog belongs to -- advice from such a knowledgeable person is often extremely valuable.

If we knew everything about genetics, we wouldn't *have* problems with our dogs any more. We'd eliminate Hip Dysplasia, PRA, heart problems, thyroid problems, seizures, etc. within a few generations if we knew everything. Unfortunately it's an art that few people are actually very good at.

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