

DOES THE DAM CONTRIBUTE MORE THAN THE SIRE?

Exploring Mitochondrial DNA

You've undoubtedly heard the debate before: those who insist the dam of the puppies has a greater genetic influence on them than the sire has, and those who just as adamantly insist that notion is biologically impossible. The sire and dam each contribute the same number of genes from their own DNA during mitosis, and those genes match up and form the new DNA helixes in each puppy, right? So the genetic influence from each parent must be exactly 50/50, right? Well, yes – when you're talking about nuclear DNA. However, there is the mitochondrial DNA to consider as well. (The what? Stay with me here!).

Mitochondria are the 'engines' or 'energy factories' of the cells. They have completely different DNA (and proteins, etc.) than the "host" cell. Our current understanding of mitochondria indicates that they were likely an independent organism that were engulfed by cells, contributed something beneficial to the host (called symbiosis), and gradually co-evolved with the host over hundreds of generations to become an integral part of the host cells. In the process, it lost its ability to exist outside the host, and the host cell lost its ability to function without the mitochondria.

So, what do these mitochondria do? In the most basic sense, the mitochondria converts the chemicals you ingest (colloquially known as "food") into ATP, which the cell can use for things like building proteins, making DNA, contracting muscles, signaling each other (think nerve cells), and inducing cell death, which controls development (chicken feet are like duck feet, but action of the chicken's mitochondria 'kills' the webbing between the toes). Further, the mitochondria are responsible for keeping the muscles supplied with usable energy, both for short bursts and for endurance - so they contribute heavily to everything from simply breathing to running, jumping and work.

Of interest to breeders, the mitochondria also drive the sperm 'motors' (although the sperm's mitochondria do not enter the egg). Whether breeding naturally or using fresh-chilled or frozen semen, things like sperm motility and longevity are of crucial importance, and no gene that a stud dog encodes will alter the mitochondria your brood bitch provides - so the resulting male puppies' sperm only swim as fast and long as their dam's mitochondria are able to keep up with the demand.

Wait – their dam's mitochondria? Yes, and that is the key: mitochondrial DNA is passed to the progeny only from the female parent. It is for this reason that paleo-geneticists have been able to track human development and cultural migration back through time -- by tracing the mitochondrial DNA on the female side of our modern families. For dog breeders, this is obviously a very important contribution to the biology of the puppies, and underscores the vital importance of a strong dam line in breeding ventures.

So, does the brood bitch contribute more than 50% to the puppies? If one considers only nuclear (cellular) DNA – no. But due to the fact that she, and only she, provides all of the mitochondrial DNA to her progeny, one would not be wrong in saying that the dam's genetic contribution indeed extends beyond that of the sire.