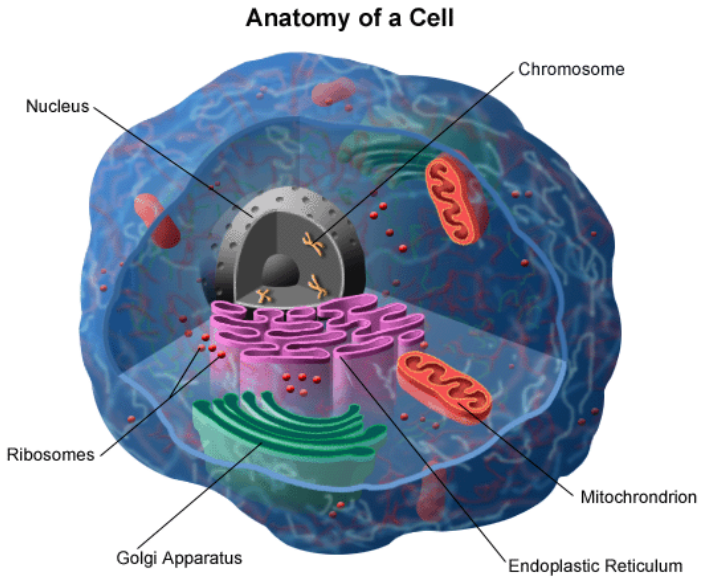
Genetics 101

To understand genetics, a basic knowledge of cell structure, cell division and the replication of DNA is necessary. Every dog starts with just 2 cells - a sperm cell and an ova or egg cell. Each of these cells have a nucleus, cytoplasm, and organelles which include the mitochondria.

The nucleus is the "brain" of the cell. It contains the DNA that is passed from generation to generation. Within the nucleus are the chromosomes - the structures that are made of DNA - the genetic "code" for replication of the cell and the dog. A dog has 39 pairs of chromosomes. There are 38 pairs of chromosomes that are called autosomal chromosome s - these chromosomes are found in both sexes. They can be passed from either parent to both sexes of progeny. There is one pair of sex chromosomes. Females have 2 X chromosomes, males have an X and a Y chromosome. A bitch can pass her X chromosome to either sex of puppy, the sire can pass an X chromosome only to a female puppy, and the Y chromosome only to a male puppy. Therefore it is the sex chromosome from the sire that determines the sex of the puppy.

There is also DNA in the mitochondria. There are no chromosomes in the mitochrondria, the DNA is in a circular configuration. This DNA can only be passed from the bitch to her puppies. The puppy will not inherit any mitochrondrial DNA from the sire. A male puppy will not pass this mitochondrial DNA to his progeny. This DNA does not affect the structure, color, etc of the puppy but mutations in this DNA can result in metabolic disorders, such as genetic diseases of muscle. This DNA codes specifically for the metabolic function of the mitochrondria - which is the powerhouse of the cell. Most of the "energy" required for the function of the cell is "manufactured" in the mitochrondria.



http://www.chop.edu/export/system/galleries/images/hospital/conditions/overview-of-chromosome-abnormalities-125933.gif

The mitochrondrial DNA (mtDNA) has been used to trace the origin of European humans back to 7 "clan mothers" or single females. Conceivably this could also be used in determining the "breed" background of a dog, however it is expensive, tedious, and requires the mtDNA of many dogs (to answer a question that was asked during the Breeders Ed. seminar at Nationals.

Next - coming soon - DNA