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Doggy Genes

Newly Sequenced Genome Could Shed Light on Human Diseases

July 1, 2006 — Molecular biologists have completely sequenced the first dog genome. Understanding how genetics plays a role in canine diseases could lead to new treatments for diseases shared by humans, such as diabetes, epilepsy and cancer. Breeders could also soon be able to check the purity of pedigrees by sending dogs' cheek swabs to the lab.

ROCKVILLE, Md. -- We may be more like dogs than we think. Now, a complete map of dog genes not only helps explain what gives dogs their unique set of traits, behaviors, and diseases -- it could help identify human diseases, too.

Why are some dogs excellent ball chasers and others perfect for your lap? The answer to dog differences is hidden in specific sequences of DNA called genes.

A standard poodle, named Shadow, was the first dog to have its genes mapped, but it was only about 80-percent complete. For the first time, molecular biologists have completely mapped out the genes of a boxer.

"The boxer genome will help us get at the genes responsible for diseases and traits in dogs," says Ewen Kirkness, a molecular biologist at The Institute for Genomic Research in Rockville, Md.

Dogs and humans share many of the same diseases, like diabetes, epilepsy and cancer. Mapping dog genes could be the chief tool in finding disease-causing genes in people, because Kirkness says the same genes will be responsible for similar diseases in humans.

Genes that cause disease in dogs are easier to find than in people. Mutations in a dozen different genes can cause human disease, almost impossible to find. In dogs, only one gene mutation can cause a disease, and that same mutated gene causes an identical disease in humans.

"Then we have a better handle on what is causing the disease in humans, also," Kirkness says.

Studying dog families also helps get a better handle on their own health and help eliminate dog diseases. "Testing can be done by breeders to limit the passage of these mutations into future generations." Having a genetic map may also mean owners of pure-bred dogs and mutts may soon be able to document which breeds their dogs come from by simply sending a cheek swab or blood sample to a genetics lab.

BACKGROUND: For the first time ever, scientists have successfully sequenced the entire genomic structures of two dog breeds: the boxer and the poodle. This is a major step forward for research in such fields as veterinary medicine. Extending this work to the human genome could help doctors better understand and fight human diseases and illnesses, including cancer research.

THE STUDY: In a new study, scientists at the Institute for Genomic Research found distinct genetic differences between boxer and poodle dog breeds, and went on to compare those variations in the genomes from nine other breeds, as well as the genomes from four types of wolves and a coyote. They did this by tracking short stretches of DNA that occur randomly, called short interspersed elements (SINEs), which often turn the expression of those genes up, down or even off. Ultimately they found that the overall dog population contains at least 20,000 differences.

THE IMPLICATIONS: For genomics researchers, variable SINEs can act as signposts for specific genes linked to a disease or traits. Identifying those genes is easier to do in dogs because they have been selectively bred for so long, creating the highest degree of physical and behavioral differences seen within a species. A dog genome is estimated to include 19,300 genes, and nearly all of them correspond to similar human genes. Specific breeds are predisposed, for instance, to heart disease, cancer, blindness, deafness, and other common disorders. A second study documented many of those disease-related differences.

HOW GENES WORK: Everyone has a set of chromosomes, each containing two halves, one from each parent, and each containing a complete set of gene, so that each chromosome has two copies of every gene. The "dominant" gene is the one that is expressed, such as for brown eyes. A "recessive" gene produces a particular trait -- for instance, for blue eyes -- only if its effects are not over-ridden by those of a dominant gene. Genes are normally transmitted unchanged from one generation to the next, but sometimes a mutation occurs: the structure of the gene is changed. Genetic engineers study these mutations in hopes that it may one day be possible to correct errors in genetic coding that are responsible for specific diseases or disorders.