

What Makes a Dog?

Analyzing dog DNA is helping to explain the origin, behavior, and diseases of dogs.

By

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Dogs are like ice cream flavors: There's one to satisfy nearly every taste.

Choose a size, say. A St. Bernard can weigh 100 times more than a Chihuahua. Or pick the type of coat. Poodles have long, curly hair; pugs have smooth, short coats. Or select just about any other quality. Greyhounds are lean and fast. Pit bulls are stocky and powerful. Some dogs are dumb. Others are deadly. Some protect you from burglars. Others rip your couch to shreds.

Two dogs can look and act so differently that you might think that they belong to separate species—that they're as distinct as, say, a rat and a kangaroo.

Nonetheless, as unlikely as the mismatched couple may seem, a tiny terrier and a giant Great Dane still belong to the same species. As long as one is male and the other is female, any two dogs can mate and create a litter of puppies that look like a mix of the two breeds. Dogs can even mate with wolves, jackals, and coyotes to produce offspring that can grow up and have their own babies.



A golden retriever takes it easy. *Eric Roell*

To explain how and why dogs can differ in so many ways yet still belong to the same species, scientists are going straight to the source: dog DNA.

Instruction manual

DNA is like an instruction manual for life. Every cell contains DNA molecules, and these molecules include genes, which tell cells what to do. Genes control many aspects of an animal's looks and behavior.

This spring, researchers from the Whitehead Institute for Biomedical Research in Cambridge, Mass., expect to complete a detailed scan of the entire set of DNA in a boxer named Tasha. They'll be able to compare the boxer's DNA to that of a poodle. A different group of scientists analyzed a poodle's DNA last fall (see <http://sciencenewsforkids.org/articles/20031001/Note3.asp>). Others are starting to work on DNA belonging to each of three other dogs: a mastiff, a bloodhound, and a greyhound.

A wealth of important information lies within the genes of dogs. Already, analyses of dog DNA are helping to explain when and how wolves first left the wild and became pets. In the future, pinpointing which genes do what may help breeders create calmer, cuter, or healthier dogs.

The health of people may be at stake, too. Dogs and people suffer from about 400 of the same diseases, including heart disease and epilepsy, says Norine Noonan of the College of Charleston in South Carolina.

Dogs may be helpful for studying a variety of human diseases. It's not even necessary to keep dogs in the lab, says geneticist Gordon Lark of the University of Utah in Salt Lake City. A simple blood test or saliva sample is enough for researchers to extract DNA for analysis.

"Cancer is the number one killer of dogs after age 10," Noonan says. "By understanding cancer in dogs, perhaps we can find a window into understanding cancer in humans."

"This is the current disease frontier," Lark says.

Dog diversity

Belonging to as many as 400 different breeds, dogs are perhaps the most diverse species of animal on Earth. They're also one of the most vulnerable to ailments, having more genetic problems than nearly any other animal.

These problems spring in large part from the breeding process itself. To create a new type of dog, a breeder typically mates dogs that share a particular trait, such as snout length or running speed. When puppies are born, the breeder selects the ones that have the longest snouts or run fastest to mate in the next round. This goes on for generations, until a new breed of long-snouted or super-fast dogs makes its way into competitions and pet stores.

By choosing dogs that look or act a certain way, the breeder is also choosing genes that control those traits. At the same time, though, genes that cause diseases can get concentrated in the population. The more closely related two animals are, the higher are the chances that their offspring will suffer genetic diseases or other problems.

Different breeds tend to have different problems. Greyhounds' very light bones make them fast, but a greyhound can break its legs just by running. Dalmatians often go deaf. Heart disease is common in boxers. Labradors have hip problems.

In January, researchers in the United Kingdom started to survey how common dog diseases are in various breeds. With the hope of designing better screening and treatment programs, the scientists have asked more than 70,000 dog-owners to provide information about their dogs.

Best friend

Studying dog genes may also help explain when and how dogs became "man's best friend."



Scientists are analyzing the DNA of Tasha, a female boxer. *NHGRI*

No one knows for sure how it happened, but one popular story goes like this: About 15,000 years ago in central Russia, our ancestors were sitting around a fire. A particularly brave wolf crept closer and closer, drawn by the smell of food. Feeling sympathetic, someone threw a leftover bone or scrap of food to the animal.

Eager for more food, the wolf and its pals began to follow human hunters from place to place, flushing out game for them. As a reward, people took care of the animals and fed them. Eventually, wolves moved into the human community, and a relationship began. Tamelessness was the first trait people selected for. Different shapes, sizes, colors, and temperaments came later. The modern dog was born.

Recent genetic analyses suggest that domestication probably happened independently in six places in Asia, says Deborah Lynch of the Canine Studies Institute in Aurora, Ohio.

Some researchers speculate that wolves may have tamed themselves simply by hanging around Stone Age garbage dumps. Wolves that weren't scared off by people had a better chance of getting food and surviving.

There's also genetic evidence suggesting that tameness itself goes together with changes in body chemistry that allow for a greater variety of body shape, coat color, and other traits among dogs.

Solving problems

New information about dog genetics is helping scientists find ways to rid dogs of certain undesirable types of behavior.

Burmese mountain dogs are one example, Noonan says. The muscular dogs used to be extremely aggressive. Through a careful study of heredity, scientists tracked down a gene responsible for this aggression and bred dogs that don't have it.

Other behaviors may be more difficult to chuck out. "We know of no genes for peeing in the house or chewing up shoes," Noonan says.

Some things may never change.



The Chesapeake Bay Retriever is known as an intensely loyal, protective, sensitive, and serious working dog. *Shawn Sidebottom*