

# ScienceNews*for* Students

ANIMALS GENETICS, EVOLUTION

## The turning of wolves into dogs may have occurred twice

**Domestication may have taken place in both the East and West, ancient DNA show**

BY TINA HESMAN SAEY JUN 22, 2016 — 7:00 AM EST



Modern dogs come in a variety of shapes and sizes. But they all have the same ancestor: the wolf. A new study shows that the process of turning wolves into dogs may have happened twice — in Europe and again in Asia.

JUDITH DZIERZAWA/ISTOCKPHOTO

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Dogs were such great friends that humans appear to have domesticated them at least twice, a new study suggests.

Domestication (Doh-MES-ti-KAY-shun) is the gradual process by which humans can produce a tame and useful animal from a wild one. This happens over countless generations. It may take thousands of years, but eventually the tamed animals can become so different from their wild ancestors that

they turn into a new species. In this case of wolves, their domestication produced dogs.

Earlier studies had indicated that the wolf-to-dog transformation happened just once. But scientists disagree about where it occurred. Some say dogs became human's best friend in East Asia. Then, last year, a study of village dogs suggested it had **happened** in Central Asia. Some studies had even hinted that Europeans were the first to turn wolves into dogs.



A 4,800-year-old dog was found here in a tomb in Newgrange, Ireland. It is the first ancient dog to have its entire genetic instruction book, or genome, deciphered.  
CARY BASS-DESCHENES/FLICKR (CC BY-SA 2.0)

In the new study, scientists analyzed the genes of bones from a 4,800-year-old Irish dog and 59 other ancient dogs. These tests suggest that canines and humans became pals in both Europe and East Asia. And it may have been as long as 14,000 years ago. Later, dogs from East Asia accompanied their human companions to Europe. The Asian dogs' bred with and replaced the European dogs, the team concluded June 3 in *Science*.

Understanding process to dog-dom may help people learn more about humans' distant past. Dogs were probably the first domesticated animal. They may have paved the way for taming other animals and plants.

In the new study, researchers put together the complete set of genes, or *genome*, of an ancient dog. Genes are made of DNA and carry instructions for building a body and all the bits and pieces inside. So a genome is like an instruction book.

The ancient dog had been found in a tomb near Newgrange, Ireland. To get at the DNA carrying the dog's genetic instruction book, researchers drilled into a bone from the dog's inner ear. The bone, called the *petrous*, is part of a skull bone that makes that knob behind your ear.

That petrous is hard as a rock, says Laurent Frantz. He is an evolutionary geneticist at the University of Oxford in England. He was also one of the scientists that took part in the new study. The hard petrous bone protects the DNA inside. So when scientists examined it after thousands of years, it still was fairly easy to read.

But it didn't tell the scientists much about what the midsize Irish dog that it came from would have looked like. From its DNA, the scientists can tell that it probably did not resemble modern dog breeds, Frantz says. "He wasn't black. He wasn't spotted. He wasn't white." Instead, the Newgrange dog was probably a mongrel with fur similar to a wolf's.

But the ancient mutt has something special in his genes. It had a stretch of mysterious DNA, points out Mietje Germonpré. She is a paleontologist at the Royal Belgian Institute of Natural Sciences in Brussels and was not part of the study. "This Irish dog has a component that can't be found in recent dogs or recent wolves." That mystery DNA, she says, could be left over from prehistoric dogs that lived in Europe. And that just might help researchers learn more about what the first dogs were like. Or it could be a trace of an extinct ancient wolf that may have given rise to dogs.

### **Digging deep into doggy DNA**

The idea that dogs came from East Asia or Central Asia is mostly based on the DNA of modern dogs. Claims that dogs have European origins had been staked on the DNA of prehistoric pups. "This paper combines both types of data" to give a more complete picture of dog domestication, says Germonpré.

Frantz's team gathered DNA data from the Newgrange dog and other ancient dogs. The scientists compared these to data from studies of modern dogs. These included the whole genomes of 80 separate dogs. The researchers also used a less-complete sampling of DNA from 605 additional dogs. They included a collection of 48 breeds and of village dogs of no particular breed.

Eastern and Western dogs are genetically different, the researchers learned. That might indicate that two separate branches of the canine family tree once existed, like distant cousins.

The Newgrange dog's DNA is more like that of the Western dogs. Since the Irish dog is 4,800 years old, the Eastern and Western dogs must have gone out on separate limbs of family tree before then. That probably happened between about 6,400 to 14,000 years ago. The new finding suggests that dogs may have been domesticated from local wolves in two separate locations during the Stone Age.

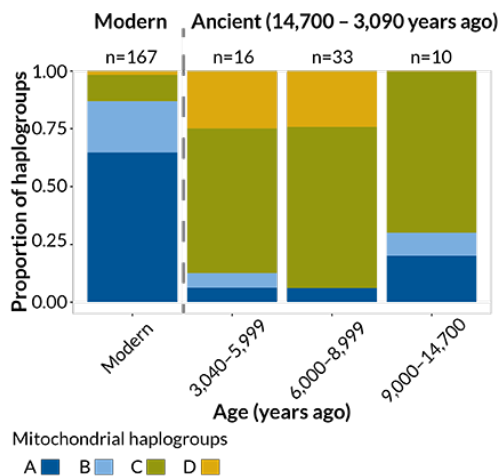
The ancient dog's DNA also may help pinpoint when that domestication took place. Frantz and his colleagues used the Newgrange dog as a known point in time. Then they counted up the genetic changes that have happened to dogs since then. From there they could calculate how quickly dogs' DNA changes, or mutates. This "mutation rate" is important for figuring out how long ago animals morphed into a new species. It also can tell researchers how fast animals can adapt to new situations.

Dogs' genes mutate at a slower rate than researchers had calculated before, the study found.

### Determining when dogs first emerged

Frantz's team used this slower mutation rate to calculate when dogs likely became different from wolves.

That split likely occurred between 20,000 and 60,000 years ago. So that could be the time period when humans began domesticating wolves. But Frantz and colleagues say that their estimate doesn't truly nail down when domestication happened. Different types of wolves could have been hanging around for a long time. Some became grey wolves like the ones living today. Others went extinct. And still others evolved into dogs. The researchers need more data to tell exactly when all of those things occurred.



The proportion of types of mitochondria that European dogs carry has changed over time. Ancient dogs from Europe and the Middle East once carried mostly the C variety, or haplogroup. Modern dogs in those regions have mostly the A haplogroup. Why? People likely introduced dogs into Europe from East Asia, which then took over genetically.  
L.A.F. FRANTZ ET AL/SCIENCE 2016

Although dogs may have started in two different places, our best furry friends have since mixed and mingled. The researchers came to that conclusion from looking at bones and at DNA from dogs' mitochondria (My-toh-KON-dree-uh). Mitochondria are like power plants inside cells, and have their own DNA. Most of a cell's DNA is stored in a compartment called a nucleus. Both a mom and dad pass that type of DNA on to their kids. But only moms also pass on their *mitochondrial DNA*.

Mitochondrial DNA comes in different "flavors" called *haplogroups*. Researchers can use those different types to figure out where a dog's mother, grandmother, great-grandmother and so on came from. The researchers compared mitochondrial DNA from 59 ancient European dogs and 167 modern European dogs. Haplogroups in the ancient European dogs were different from those in the modern dogs, the researchers found.

Still, the authors of the latest study admit they can't yet rule out that dogs were domesticated only once. Dogs could have then moved to different places early on. There, isolation, random chance and other factors might have caused them to drift apart genetically so that now their DNA looks like they started as different groups.

**Power Words**  
(for more about Power Words, click here)

**archaeology** (also archeology) The study of human history and prehistory through the excavation of sites and the analysis of artifacts and other physical remains. Those remains can range from housing materials and cooking vessels to clothing and footprints. People who work in this field are known as **archaeologists**.

**breed** (noun) Animals within the same species that are so genetically similar that they produce reliable and characteristic traits. German shepherds and dachshunds, for instance, are examples of dog breeds. (verb) To produce offspring through reproduction.

**canid** The biological family of mammals that are carnivores and omnivores. The family includes dogs, wolves, foxes, jackals and coyotes. Members of this family are known as **canines**.

**DNA** (short for deoxyribonucleic acid) A long, double-stranded and spiral-shaped molecule inside most living cells that carries genetic instructions. It is built on a backbone of phosphorus, oxygen, and carbon atoms. In all living things, from plants and animals to microbes, these instructions tell cells which molecules to make.

**domestication** A process of producing a tame version of an animal or plant from a wild one, which can take many generations. A domesticated animal is one that has been bred in captivity for food or as a pet.

**evolution** (v. to evolve) A process by which species undergo changes over time, usually through genetic variation and natural selection. These changes usually result in a new type of organism better suited for its environment than the earlier type. The newer type is not necessarily more "advanced," just better adapted to the conditions in which it developed.

**evolutionary genetics** A field of biology that focuses on how genes — and the traits they lead to — change over long periods of time (potentially over millennia or more). People who work in this field are known as **evolutionary geneticists**.

**extinct** The term for a species that no longer exists anywhere. It is gone forever.

**gene** (adj. **genetic**) A segment of DNA that codes, or holds instructions, for producing a protein. Offspring inherit genes from their parents. Genes influence how an organism looks and behaves.

**genetic** Having to do with chromosomes, DNA and the genes contained within DNA. The field of science dealing with these biological instructions is known as *genetics*. People who work in this field are **geneticists**.

**genome** The complete set of genes or genetic material in a cell or an organism. The study of this genetic inheritance housed within cells is known as **genomics**.

**haplotype** A number of genes that an organism inherits as altogether as a group from one of its parents. They were likely inherited together because they had been sitting next to each other on one of that parent's chromosomes. Often, a group of these haplotypes are inherited together. These are referred to as a **haplogroup**. Haplogroup can also refer to a number of somewhat related members of a species, all of which carry the same distinct haplotypes. Such haplogroups tend to be named for different letters in the alphabet.

**mitochondria** (sing. **mitochondrion**) A structure in all cells (except bacteria) found

outside of their nuclei. Here the cell breaks down nutrients and converts them into a form of energy known as ATP.

**mitochondrial DNA** DNA passed on to offspring, almost always by their female parent. Housed in mitochondria, this DNA is double-stranded but circular. It's also very small, only possessing a small share of the genes found in the main package of DNA, the material found in a cell's nucleus.

**mutation** (v. **mutate**) Some change that occurs to a gene in an organism's DNA. Some mutations occur naturally. Others can be triggered by outside factors, such as pollution, radiation, medicines or something in the diet. A gene with this change is referred to as a mutant.

**nucleus** Plural is nuclei. (in biology) A dense structure present in many cells. Typically a single rounded structure encased within a membrane, the nucleus contains the genetic information.

**paleontology** The branch of science concerned with ancient, fossilized animals and plants. The scientists who study them are known as **paleontologists**.

**petrous** An adjective referring to the amazingly hard and dense portion of the skull's temporal bone. It's a region that contains the internal organs required for hearing.

**prehistoric** An adjective describing a time before written record-keeping began. In fact, the term usually is applied to a time before humans existed, such as the time of the dinosaurs.

**species** A group of organisms that share similar traits and ancestry, and can usually breed to produce fertile offspring. It is also the basic rank in a classification system called taxonomy. A species name is usually given with the next highest rank, the genus.

**Stone Age** A prehistoric period when weapons and tools were made of stone or of materials such as bone, wood, or horn. This period lasted millions of years and came to an end around 10,000 to 12,000 years ago.

**taxonomy** The study of organisms and how they relate or have branched off (over evolutionary time) from earlier organisms. Often the classification of where plants, animals or other organisms fit within the Tree of Life will be based on such features as how their structures are formed, where they live (in air or soil or water), where they get their nutrients. Scientists who work in this field are known as **taxonomists**.

### Readability Score:

6.7

### NGSS:

- 3-LS4-1
- MS-LS4-2
- MS-LS4-5
- MS-LS4-6
- HS-LS4-1
- HS-LS4-2
- 3-LS3-1
- HS-LS3-2

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### Citation

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## Further Reading

S. Ornes. "[No frostbite for dogs.](#)" *Science News for Students*. February 8, 2012.

S. Ornes. "[Wet-dog physics.](#)" *Science News for Students*. November 8, 2010.

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