



Department of Biology

Concepts of Biology  
Biol 111  
Minot State University

Lecture, MWF 12:00-1 pm  
Cyril Moore Science Center, Room 16  
Lab, Tuesdays/Thursdays  
Swain Hall, Room 304

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- No SI Thursday and Sam Olson is cancelling Friday office hours too. Check Facebook.
- Exam 4---November 25<sup>th</sup> (Monday before Thanksgiving)

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Discussion Lecture 4  
November 13, 2013

Based on the February, 2012 *National Geographic* article on explaining the huge variation we see in dogs.

It's not so different than Mendel's story of peas.

Remember, the study of genetics would not have begun if Mendel hadn't notices **variation**!

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What is a species?



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### Common definition

- a group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding. The species is the principal natural taxonomic unit, ranking below a genus and denoted by a Latin binomial, e.g.,

*Homo sapiens*

*Canis lupis (familiaris)*

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Dogs have 78 chromosomes.

- Wolves have 78 chromosomes
- Jackels have 78 chromosomes
- Coyotes have 78 chromosomes

- What point am I trying to make?

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- Successful interbreeding requires keeping the chromosome number consistent. No extra or missing chromosomes in the zygote. (recall Down syndrome is one rare case of an abnormal # of chromosomes in a human---but results in significant abnormalities).
- Chromosomes must carry the genes to create a similar organism.

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Could they?...interbreed?



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- In theory...yes. They would create a dog---with 78 chromosomes. But the difference is size and anatomical structure might keep them from producing healthy pups.
- Remember, inheritance is not blending of traits. So a pup might get a set of traits that would make it unable to walk or eat or breathe.

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- What is the explanation for so MUCH variation in dogs?

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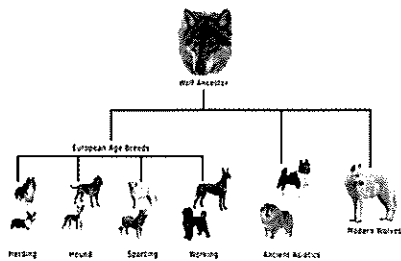
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All dogs have the wolf as their common ancestor.



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### Evolution?

- Yes—but not as nature does it.
  - Humans brought wolves into their settlements and began to notice small differences. Like Mendel they controlled breeding of their “dogs” to obtain a set of traits they liked or needed to help them do work or survive.

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### Humans have artificially selected traits in dogs.

- Remember—in nature, evolution is driven by “survival of the fittest” or *natural selection*.
- Small degrees of variation that help an individual survive in a certain environment, will be saved in the offspring of that successful individual. Individuals who do not have “survival traits” don’t have offspring.

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- In nature, the changes seen in a population are small and occur over long long periods of time ( hundreds of thousands to millions of years).
- Humans greatly accelerated the changes we see in dogs by artificially selecting traits.

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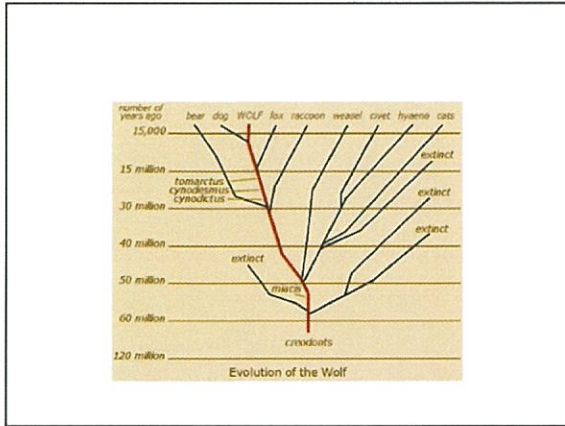
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- With ~85 breeds of dogs...are there groups that are more similar? How many groups?
- Depends on the study...or how you look at dogs.... The paper I had you read groups all dogs into 4 large groups—Wolf-like, herders, hunters, mastiff-like.

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More commonly we see 8 groups

- <http://animal.discovery.com/tv-shows/dogs-101/lists/8-dog-groups.htm>

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~85 modern breeds of dogs...

What makes them different

- Genes? Of course! Genes are the recipe for any/every organism.
- All of our genes combined is called our **genome**.
- What do you suppose has been discovered by studying the dog genome? (now called the CanMap)

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- **HUGE** differences in genes?

- Small differences in genes?

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- Actually, the CanMap (genome project for dogs) points to a relatively small *number* of genes controlling the vastly different appearances of dogs!

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How many genes control the height difference here?



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- 1 gene! (variation in a single gene) or (different alleles of one gene) make these dogs so vastly different in height.
- This is remarkable!!!!

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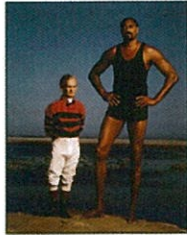
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### Same in humans?



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### Not even close!

- No---over 200 different individual genes contribute to final height of humans.
- Dogs are really the exception to variation! The results of CanMap were totally unexpected.

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### So....

- With so much variation...are dogs really one species?
  - What is the evidence for your answer? ---think genetics!

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### What can we do with this information?

- Hopefully better understand genetic diseases in dogs.
- Look for similarities in diseases in humans. Dog genetic information is already leading to new discoveries in humans.

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### As small list of studies based on dog genetics research!

- Canine Genomics & Disease Publications
- Dog Genome Paper: Lindblad-Toh, K, et al. (2005). Genome sequence, comparative analysis and haplotype structure of the domestic dog. *Nature* 438, 803-819.
- Supplemental information
- Degenerative myelopathy: Genome-wide association analysis reveals a SOD1 mutation in canine degenerative myelopathy that resembles amyotrophic lateral sclerosis. (2009) *PLoS ONE* 4:e300333.
- OCD: A canine chromosome 7 locus confers compulsive disorder susceptibility. (2010) *Mol Psychiatry* 15:8-10.
- Familial Shar Pei Fever (FSF): A Novel Unstable Duplication Upstream of HLA2 Predisposes to a Breed-Defining Skin Phenotype and a Periodic Fever Syndrome in Chinese Shar-Pei Dogs. (2011) *PLoS Genet* 7:e1001332.
- Toller diseases: Genome-wide association mapping identifies multiple loci for a canine SLE-related disease complex. (2010) *Nat Genet* 42:250-253.
- Dermoid Sinus: Duplication of FGF3, FGF4, FGF19, and ODA701 causes hair ridges and predisposition to dermoid sinus in Hideback Dogs. *Nature Genetics* 43:1038-1044.
- Hairlessness/Canine Ectodermal Dysplasia: A Mutation in Hairless Dogs Implicates FOXI3 in Ectodermal Development. *Science* DOI: 10.1126/science.1162525

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### My favorite dog...



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