What's in a Mutt? An Intro to Dog DNA Analysis

Lecture 3

Jan 11th, 2019

Mutts vs Purebreds

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	Mutts	**Purebreds**
Look like parents	✗	✓
Characteristic personality traits	✗	✓
Low risk of health problems	✓	✗
Genetically diverse	✓	✗

Mixes (but not mutts)

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One chromosome from mom, one from dad

So what might separating the puppy back out into mom and dad (genetically) look like?

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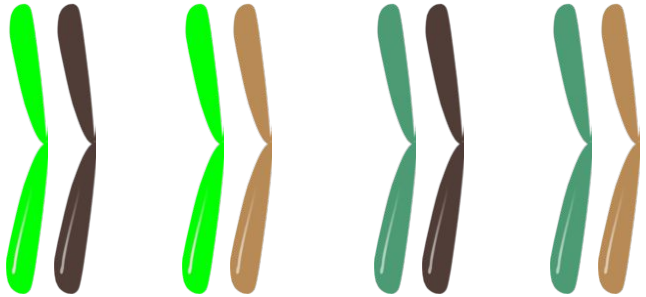
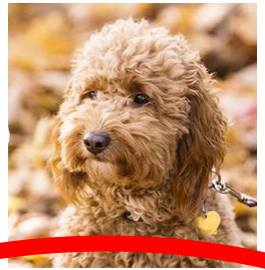
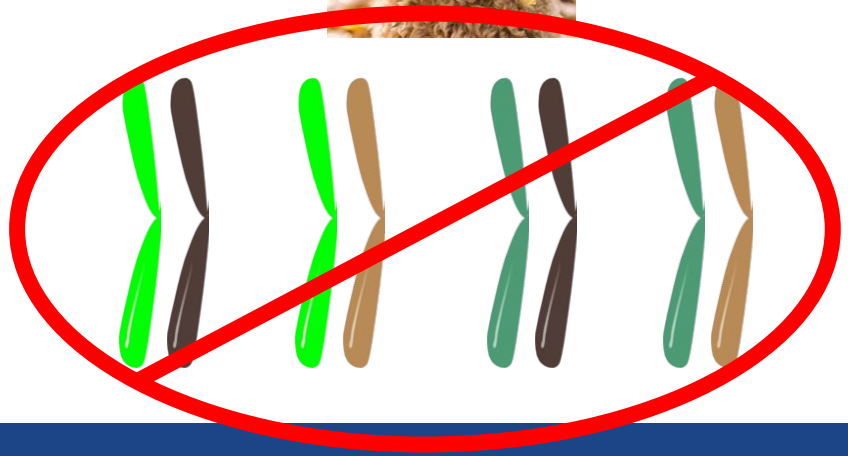


Siblings don’t just have four possible looks!

One paternal chromosome, one maternal

Chromosomes won’t perfectly match because of **recombination**.





One paternal chromosome, one maternal

The chromosome we get from a parent isn't identical to either one of their two chromosomes, it's a mixture of both!

Recombination!

One paternal chromosome, one maternal

So can we separate them? If we have examples of goldens and poodles, we can probably tell that green comes from golden retrievers and brown comes from poodles.

Recombination!

What about purebreds?

We still have recombination, but they're all more similar to each other and we consider all combinations to be goldens.

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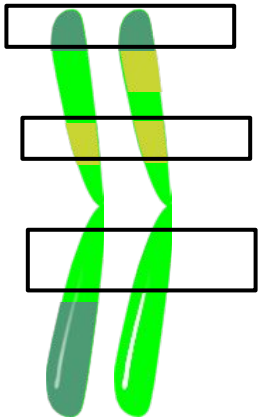
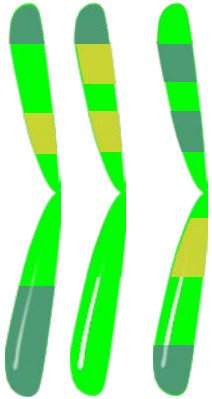


Purebreds tend to have more regions that are identical between chromosomes because they shared a common ancestor. This leads to higher **homozygosity** (same base on both chromosomes).

What about purebreds?



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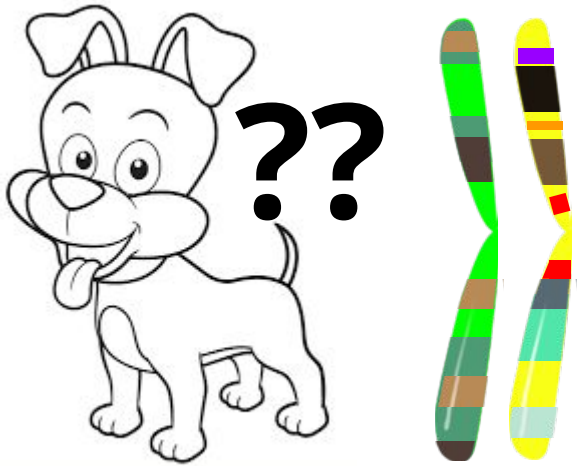

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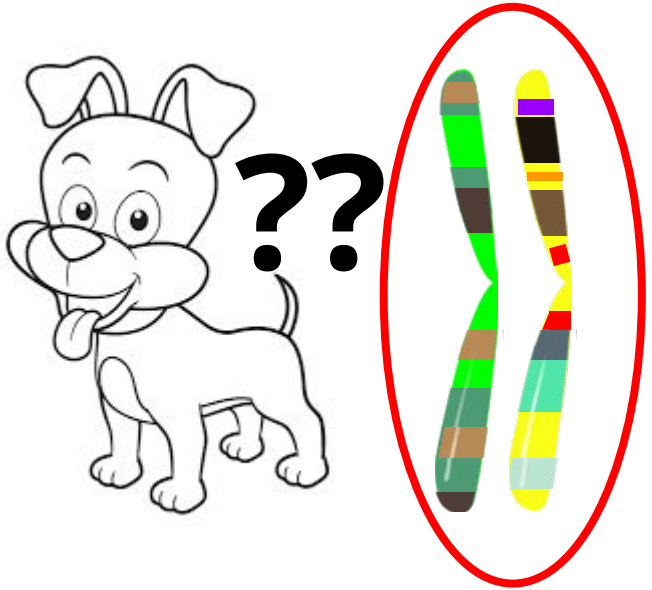

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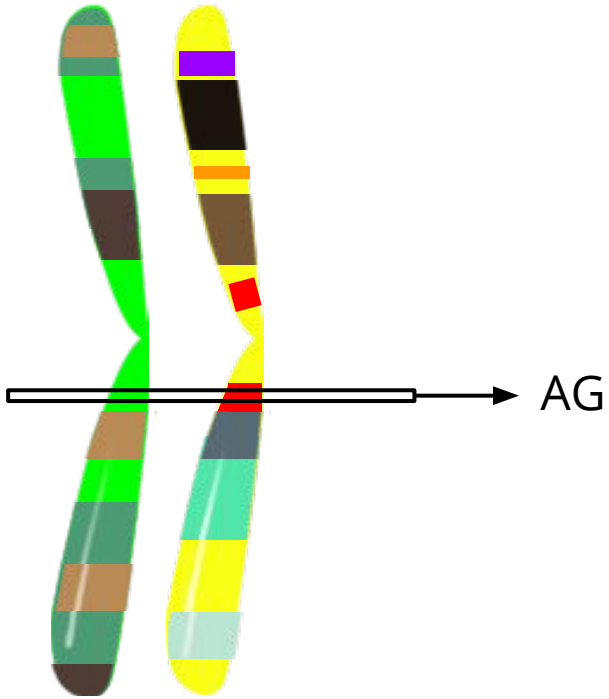
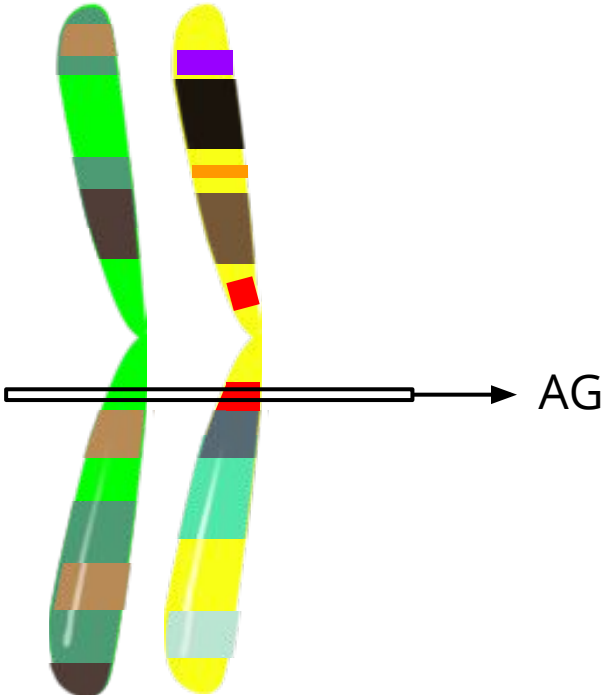


Let’s say we’re trying to compare to 3 breeds.

Goldens have **AG**
Shiba Inus have **AA**
Chow chows have **GG**

Which breed(s) is this mutt most likely to be?

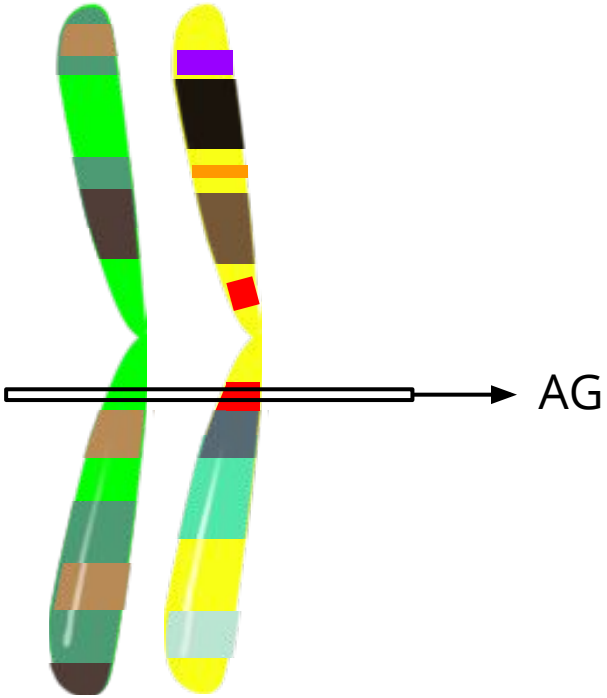
What about mutts?



Could be any combo of two of chow/shiba/golden, or could be all golden.

We can’t tell.

What about mutts?



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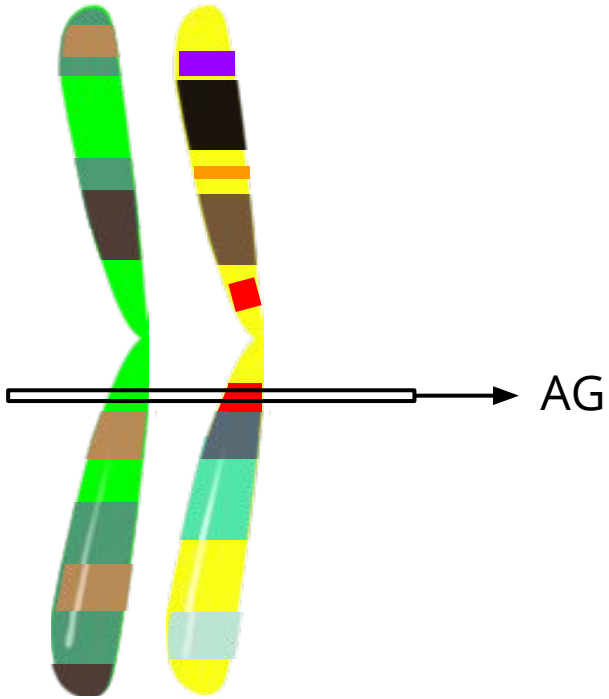

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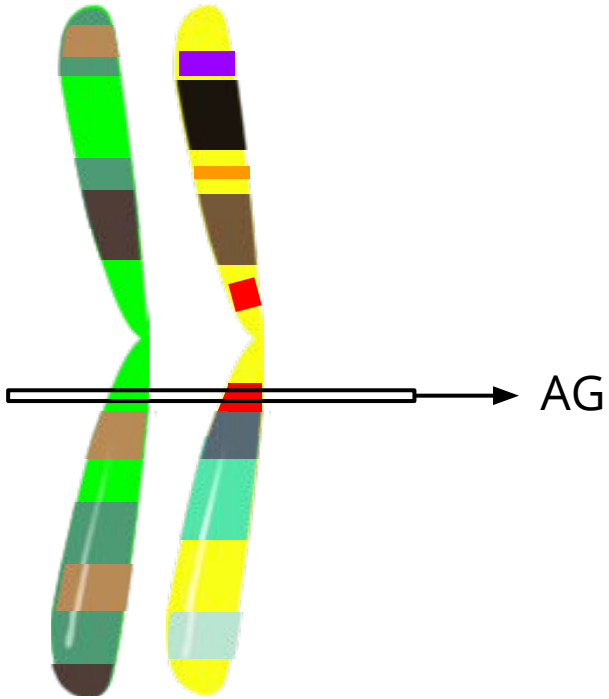

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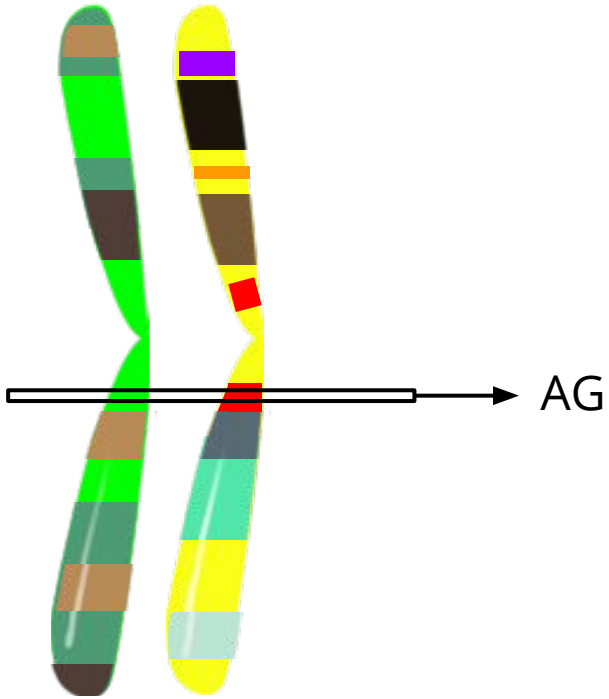

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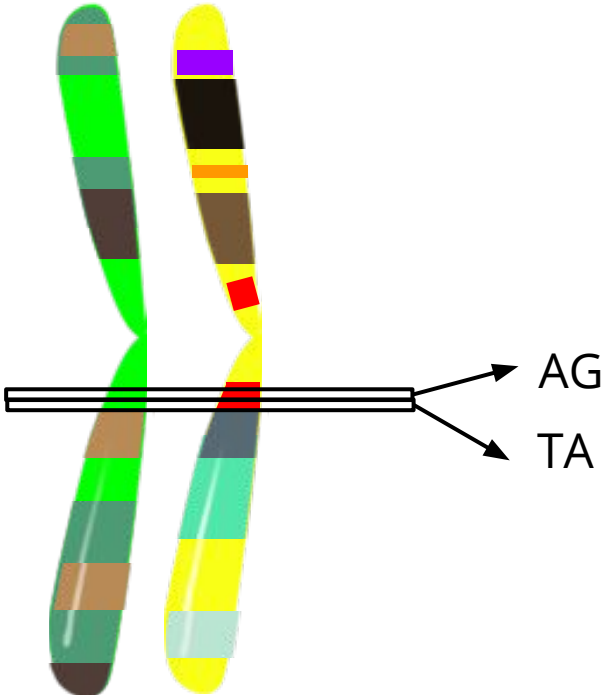

Let’s say we’re trying to compare to 3 breeds.

	SNP1	SNP2
Goldens have	**AG**	**AA**
Shiba Inus have	**AA**	**AA**
Chow chows have	**GG**	**TT**

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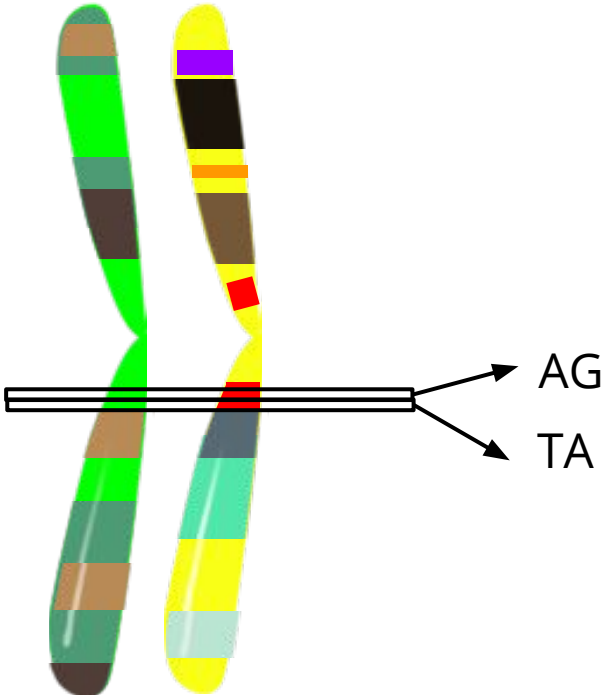

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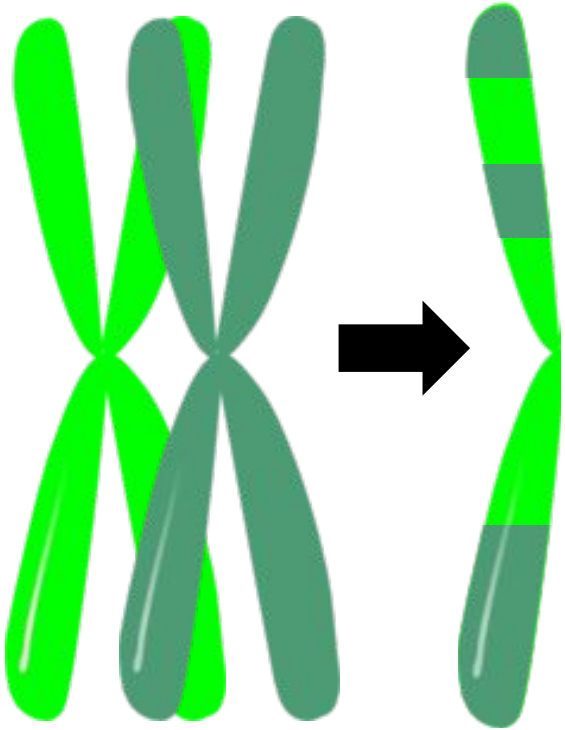
Since the SNPs are very close together, we assume they're from the same ancestral chunk of DNA.

Aside on linkage



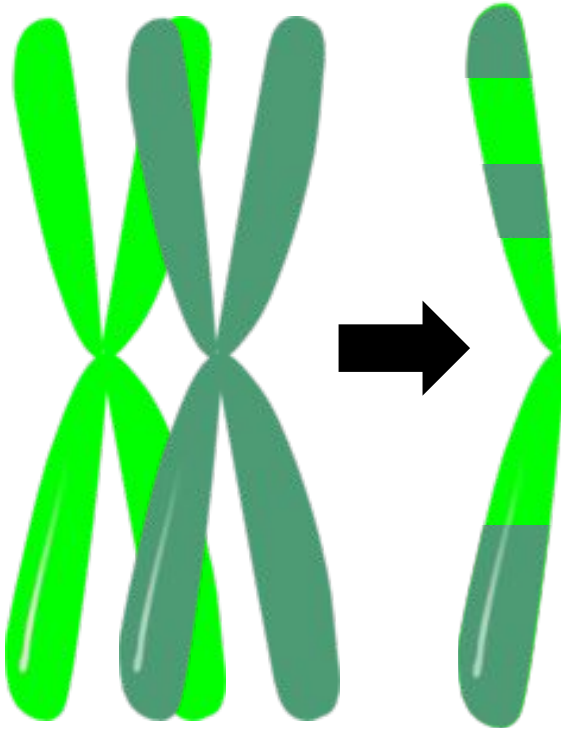
(x4 egg or sperm cells, all different)

When chromosomes recombine, they do so in pieces.

Centimorgan: a physical measure of distance on a chromosome

We know how many cM apart our SNPs are, and this can be used to calculate how likely it is they're inherited together.

Aside on linkage



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Johns Hopkins yearbook of 1891

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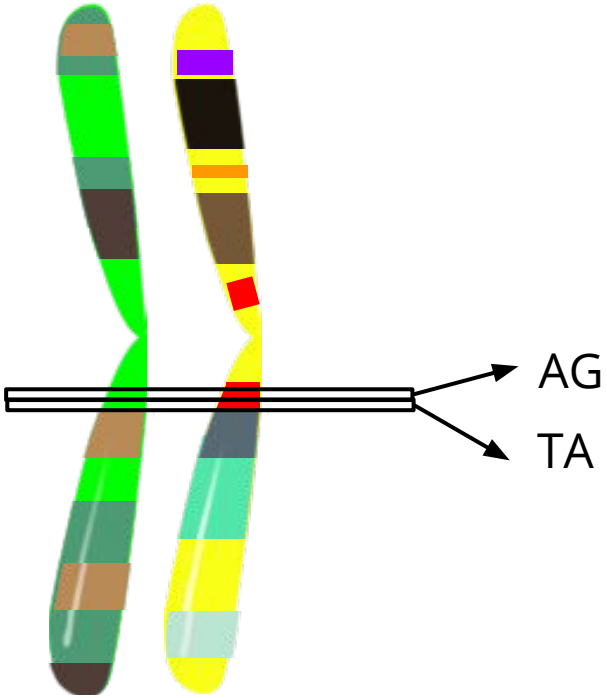

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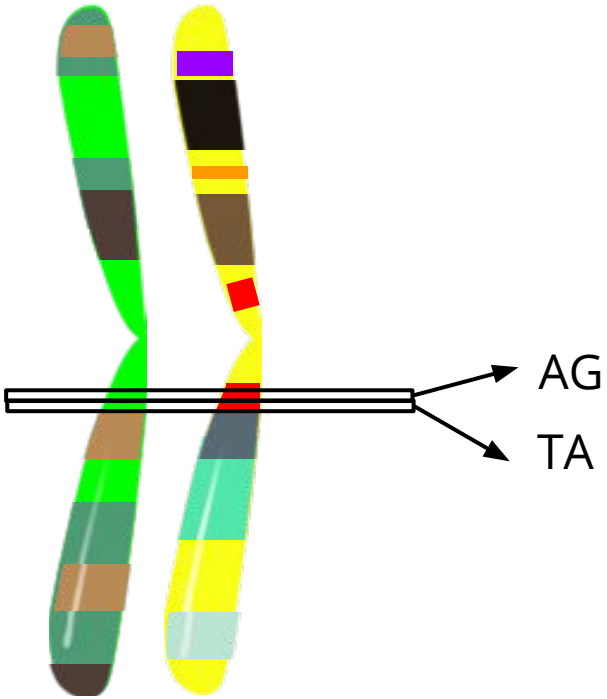
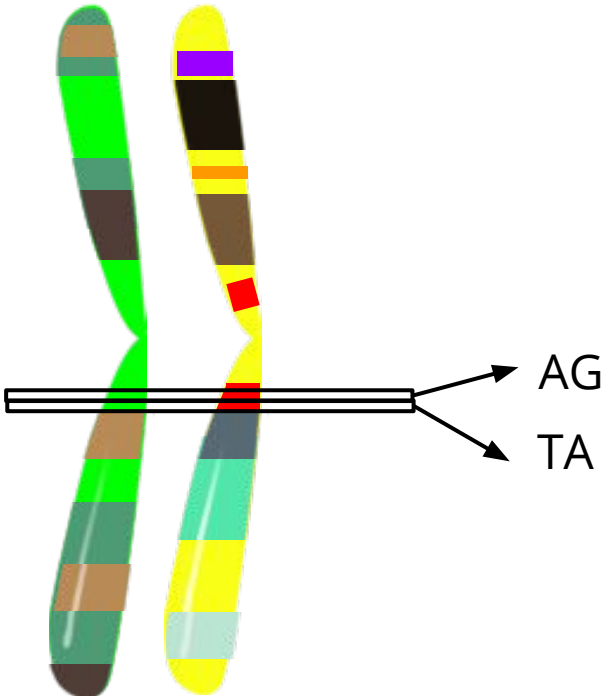
What about mutts?



	ChromA	ChromB	
Goldens can have	**A**	**G**	SNP1
	A	**A**	SNP2
Shiba Inus can have	**A**	**A**	
	A	**A**	
Chow chows can have	**G**	**G**	
	T	**T**	

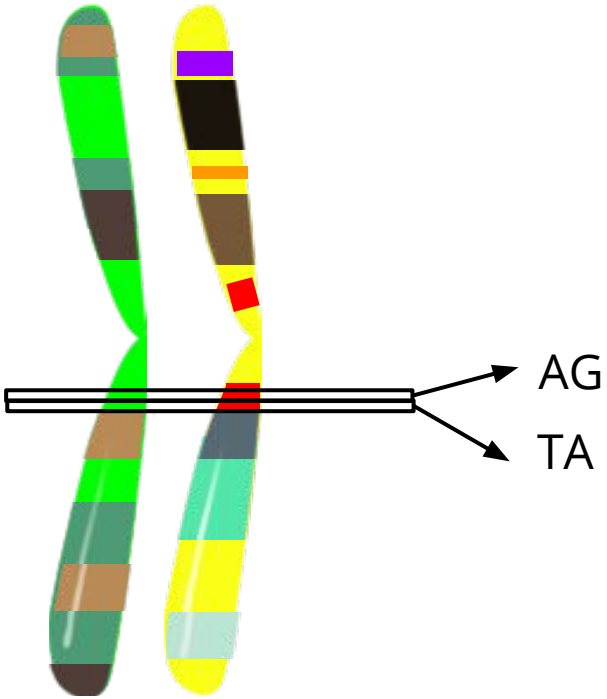
What can our mutt have?

What about mutts?



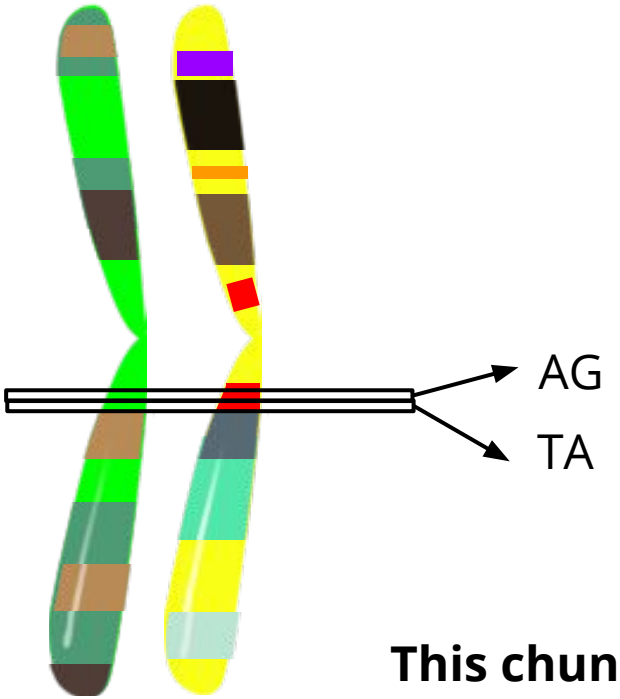
	ChromA		ChromB		
Goldens can have	**A**		**G**		SNP1
	A		**A**		SNP2
Shiba Inus can have	**A**		**A**		
	A		**A**		
Chow chows can have	**G**		**G**		
	T		**T**		
Our mutt can have	A	G	**OR**	A	G
	T	A		A	T

What about mutts?



	ChromA	ChromB	
Schnauzers can have	**A**	**G**	SNP1
	A	**A**	SNP2
Shiba Inus can have	**A**	**A**	
	A	**A**	
Chow chows can have	**G**	**G**	
	T	**T**	
Our mutt can have	~~A~~	G	**OR** A G
	~~T~~	A	A T

What about mutts?



Schnauzers can have **A A** **G A**

Shiba Inus can have **A A** **A A**

Chow chows can have **G T** **G T**

Our mutt can have ~~A T~~ G A **OR** A G / A T

This chunk of DNA on one of the chromosomes is definitely chow!

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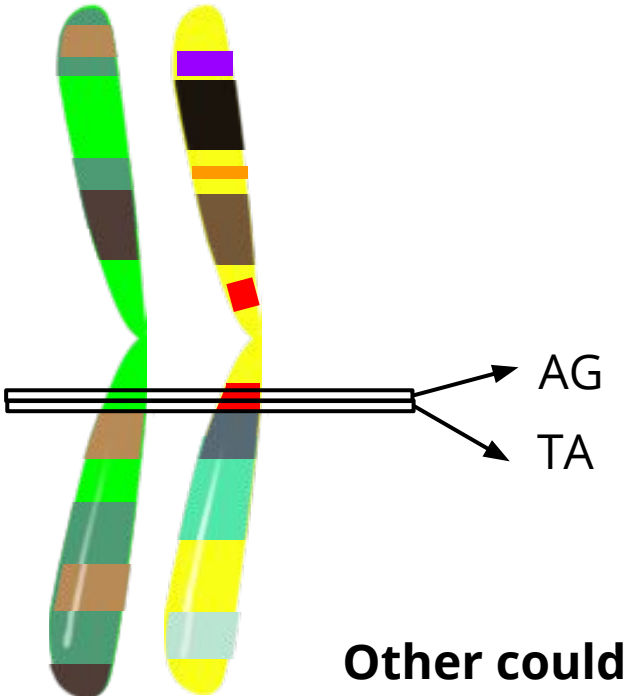

Schnauzers can have **A A** **G A**

Shiba Inus can have **A A** **A A**

Chow chows can have **G T** **G T**

Our mutt can have ~~A T~~ G A **OR** A G A T

Other could be Shiba or Golden, can look at more nearby SNPs.

Phasing

The idea that close together SNPs are inherited together is called ***linkage***.

The process of teasing apart the sequences (for us, SNPs) on each of the two chromosomes is called ***phasing***.

Each chromosome's single base genotypes make up a ***haplotype.***