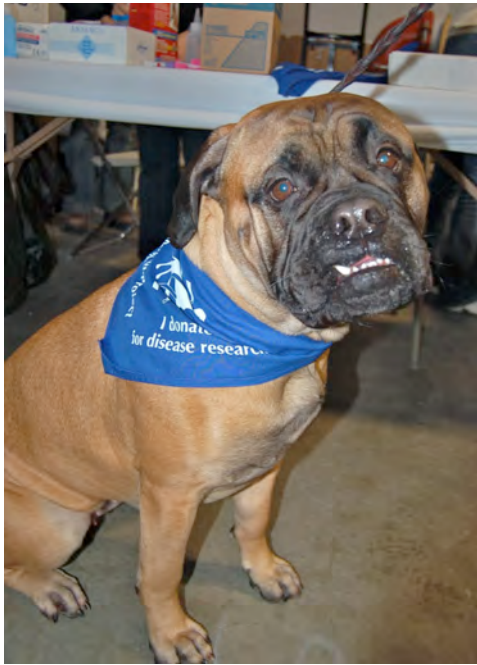




My research collaborators:

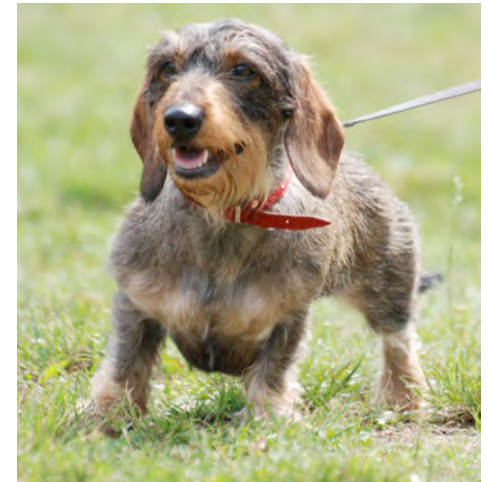


Golden Retriever



Can you match these dogs to each behavior?

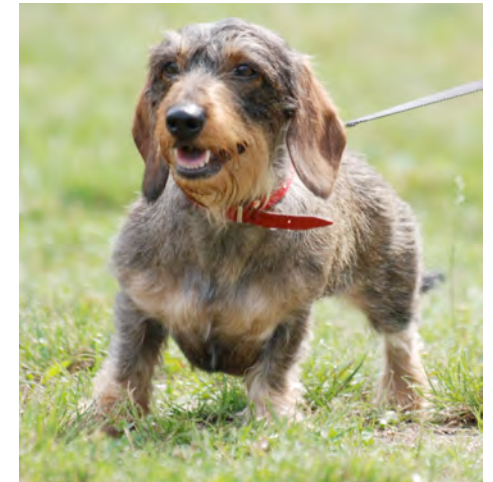
- a) Tracking
- b) Racing
- c) Herding
- d) Companionship

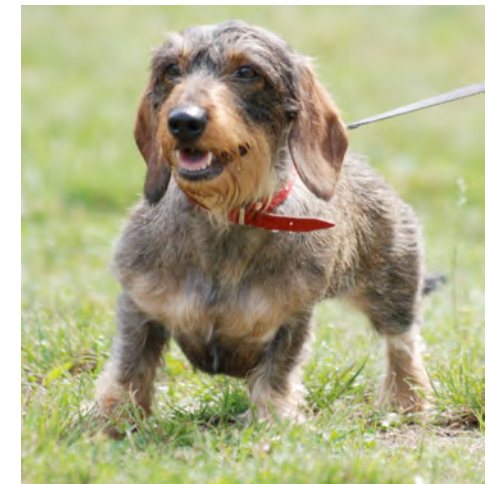




Can you match these dogs to each behavior?

- a) Tracking
- b) Racing
- c) Herding
- d) Companionship





Can you match these dogs to each behavior?

- a) Tracking **Dachshund**
- b) Racing
- c) Herding
- d) Companionship



Can you match these dogs to each behavior?

- a) Tracking
- b) Racing **Greyhound**
- c) Herding
- d) Companionship



Can you match these dogs to each behavior?

a) Tracking

b) Racing

c) Herding **Border Collie**

d) Companionship



Can you match these dogs to each behavior?

a) Tracking

b) Racing

c) Herding

d) Companionship

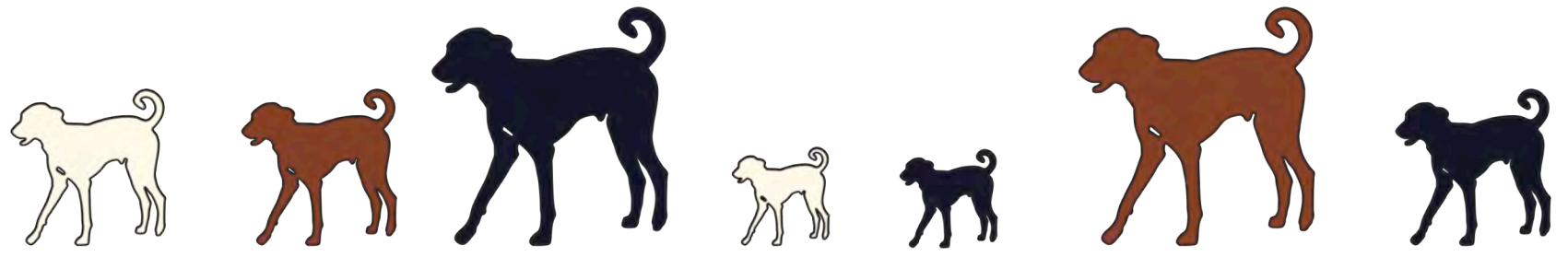
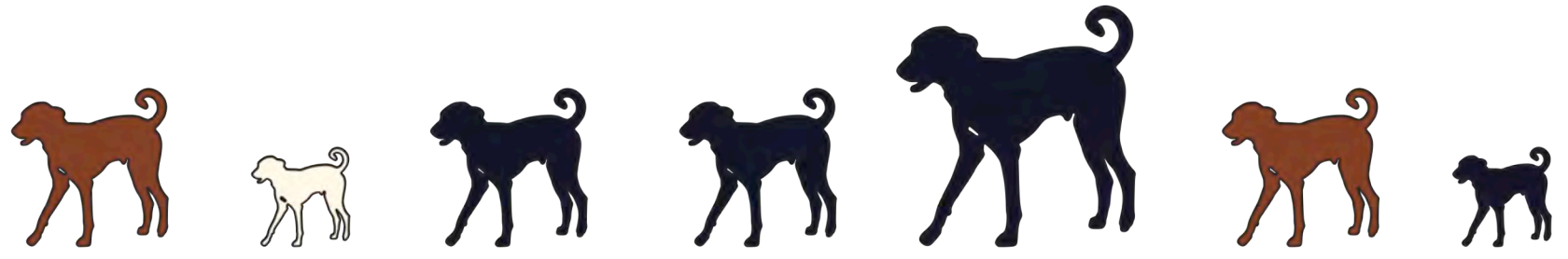
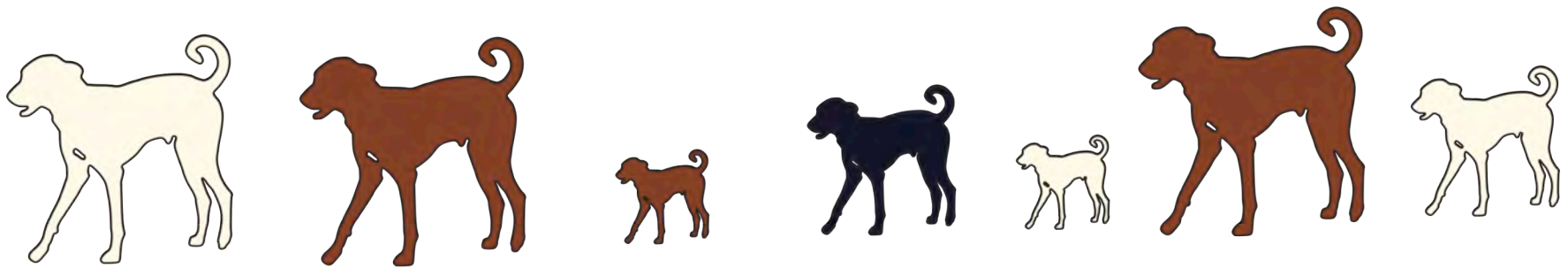
Pekingese

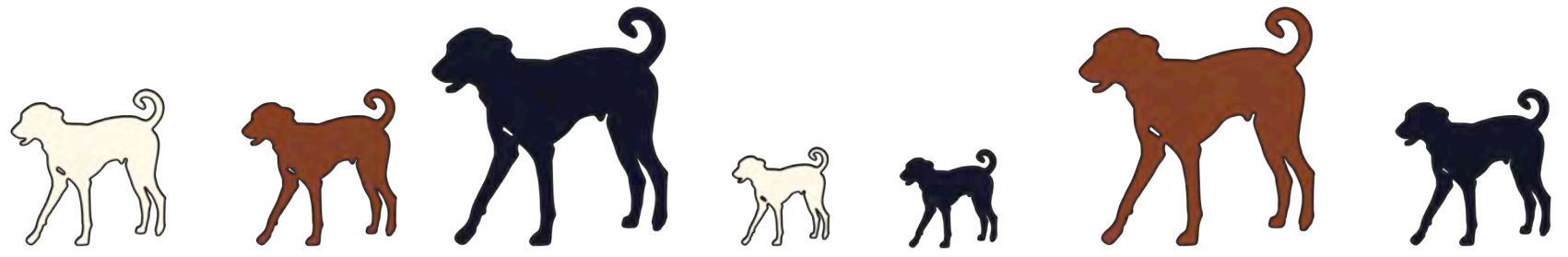
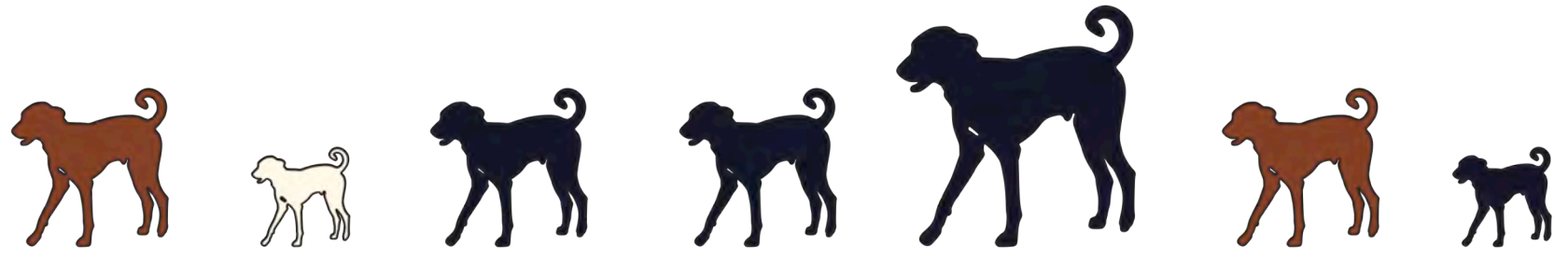
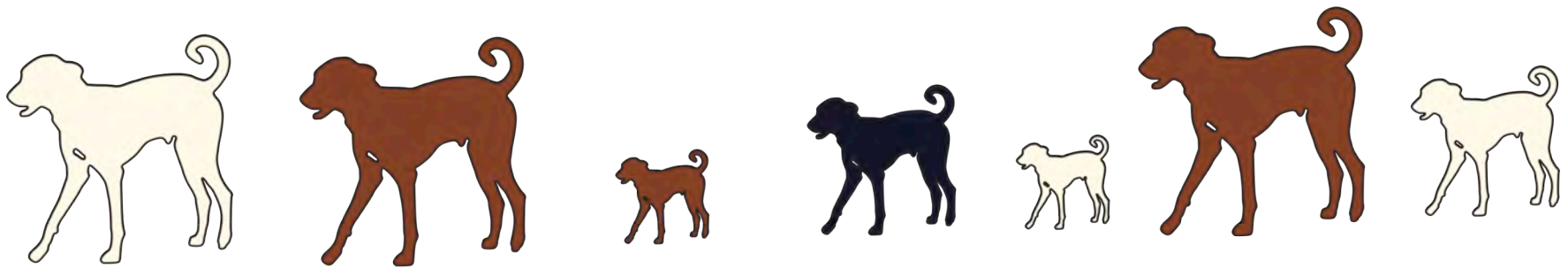


Can you match these dogs to each behavior?

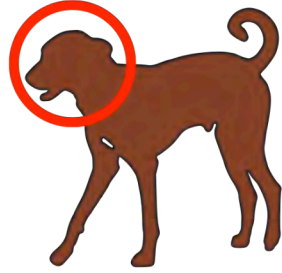
- a) Tracking
- b) Racing
- c) Herding
- d) Companionship

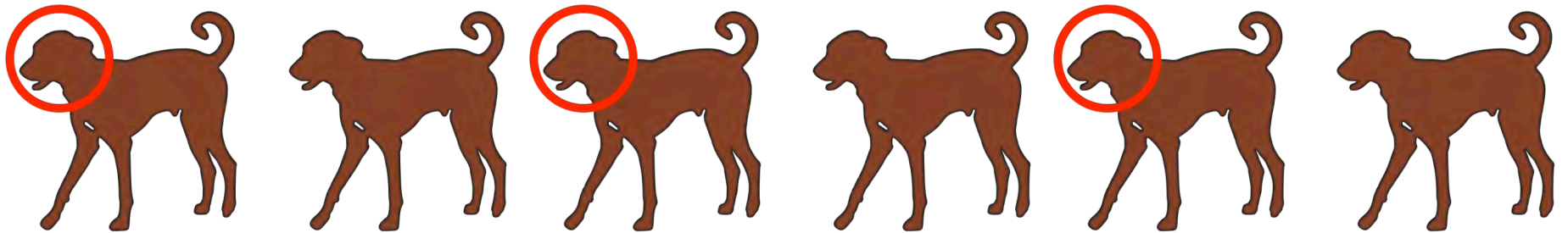
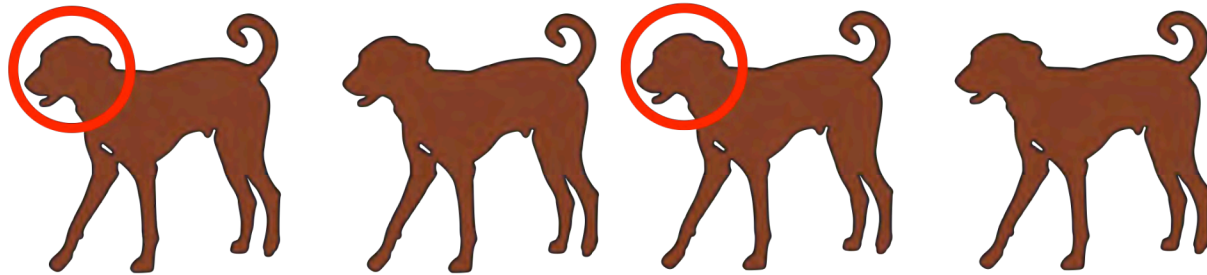
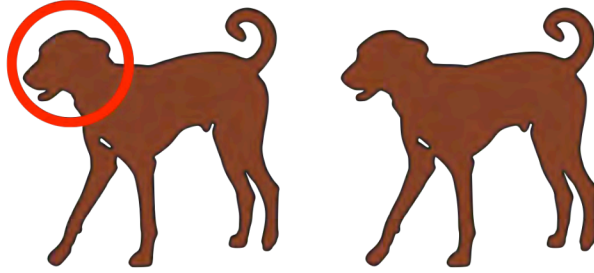


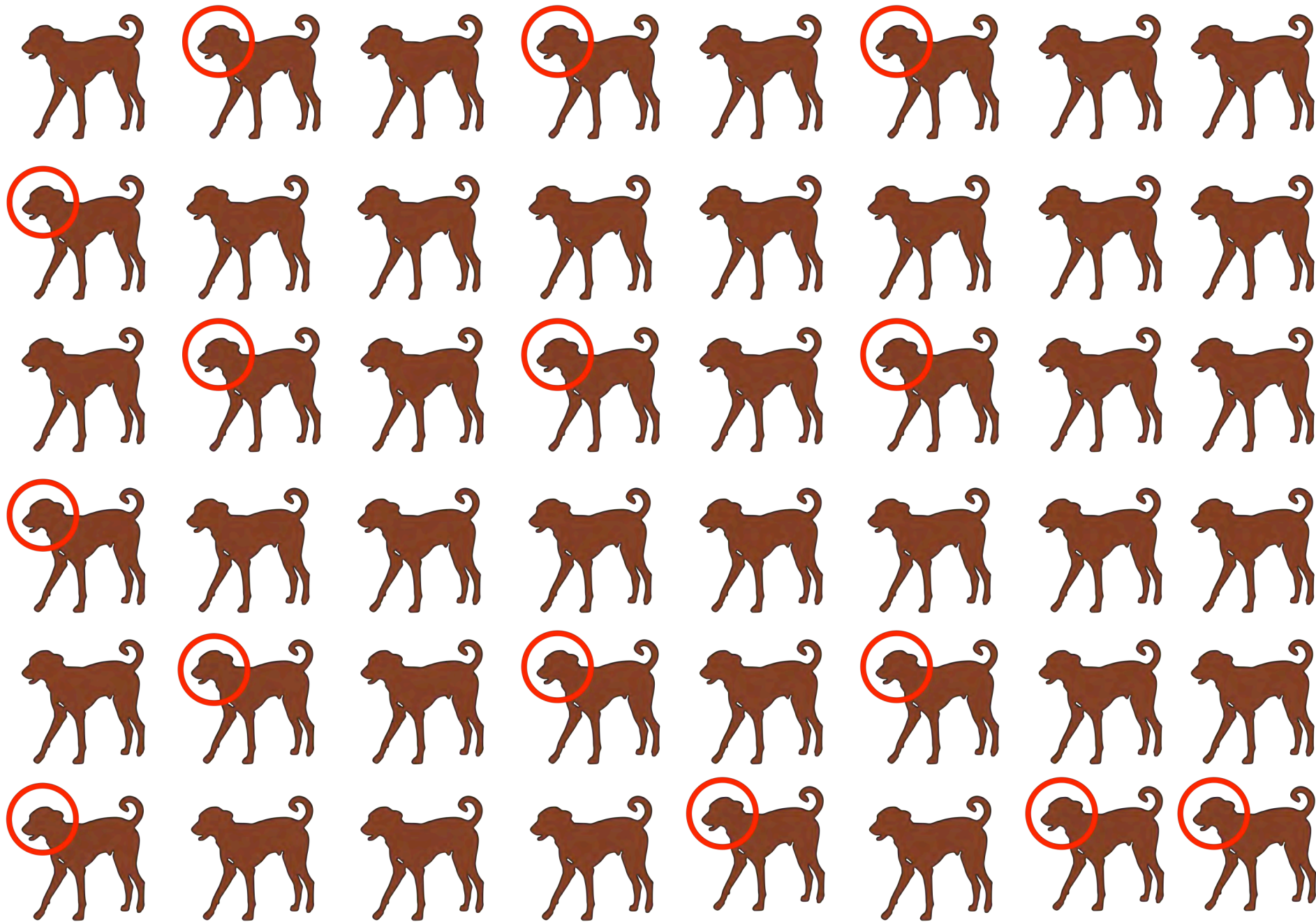












**What kind of diseases do
dogs get?**

The same ones people get!

Blindness

Deafness

Cancer

Diabetes

Heart Disease

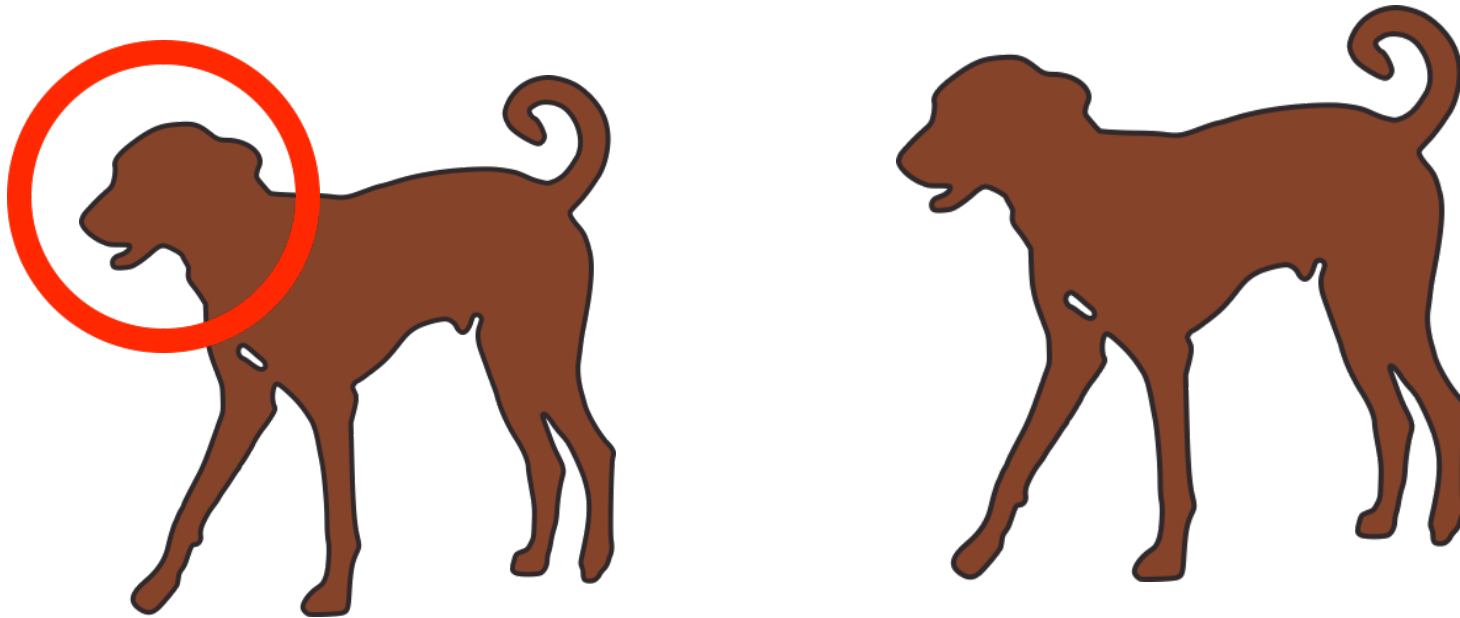
Epilepsy

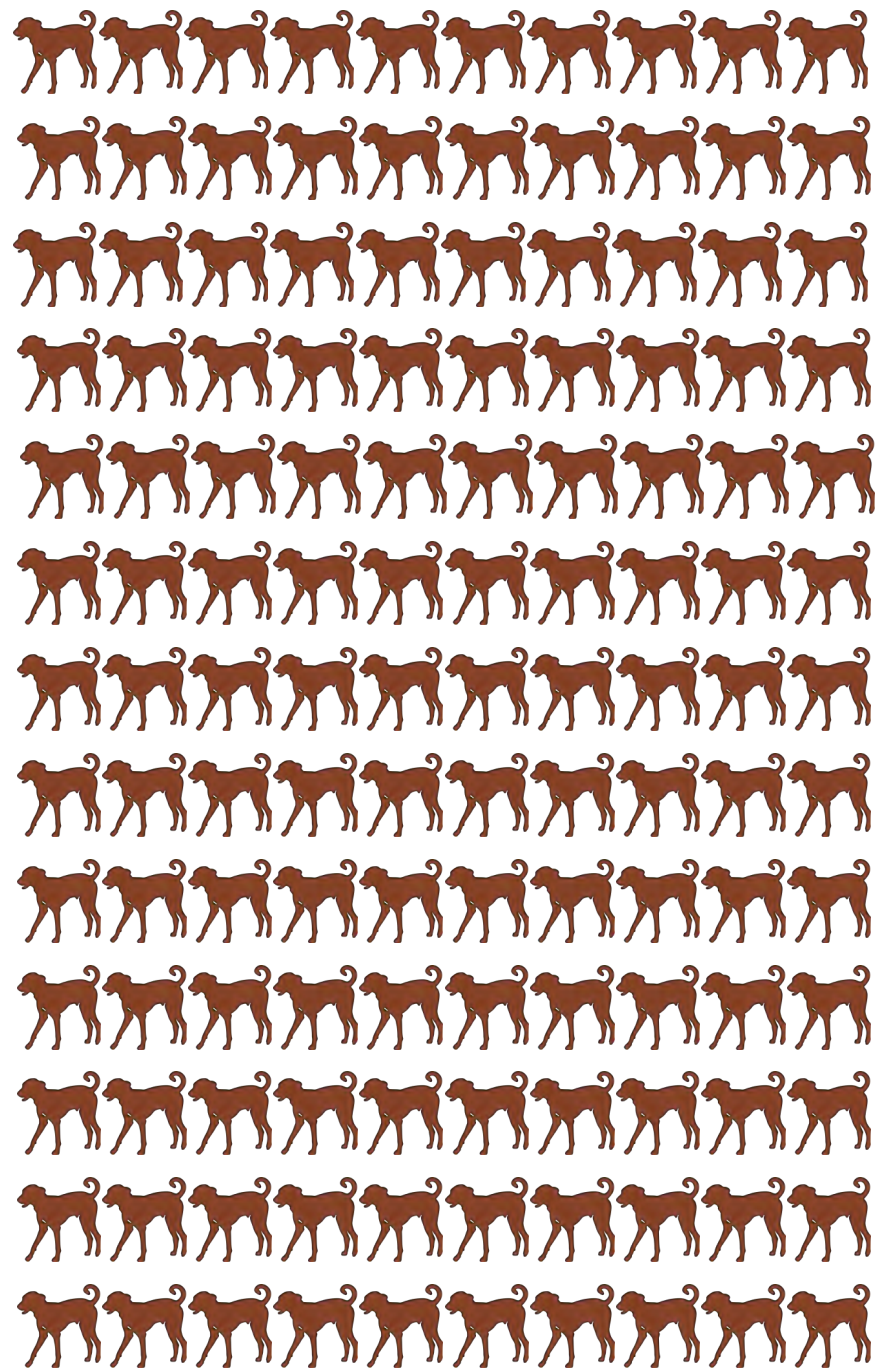
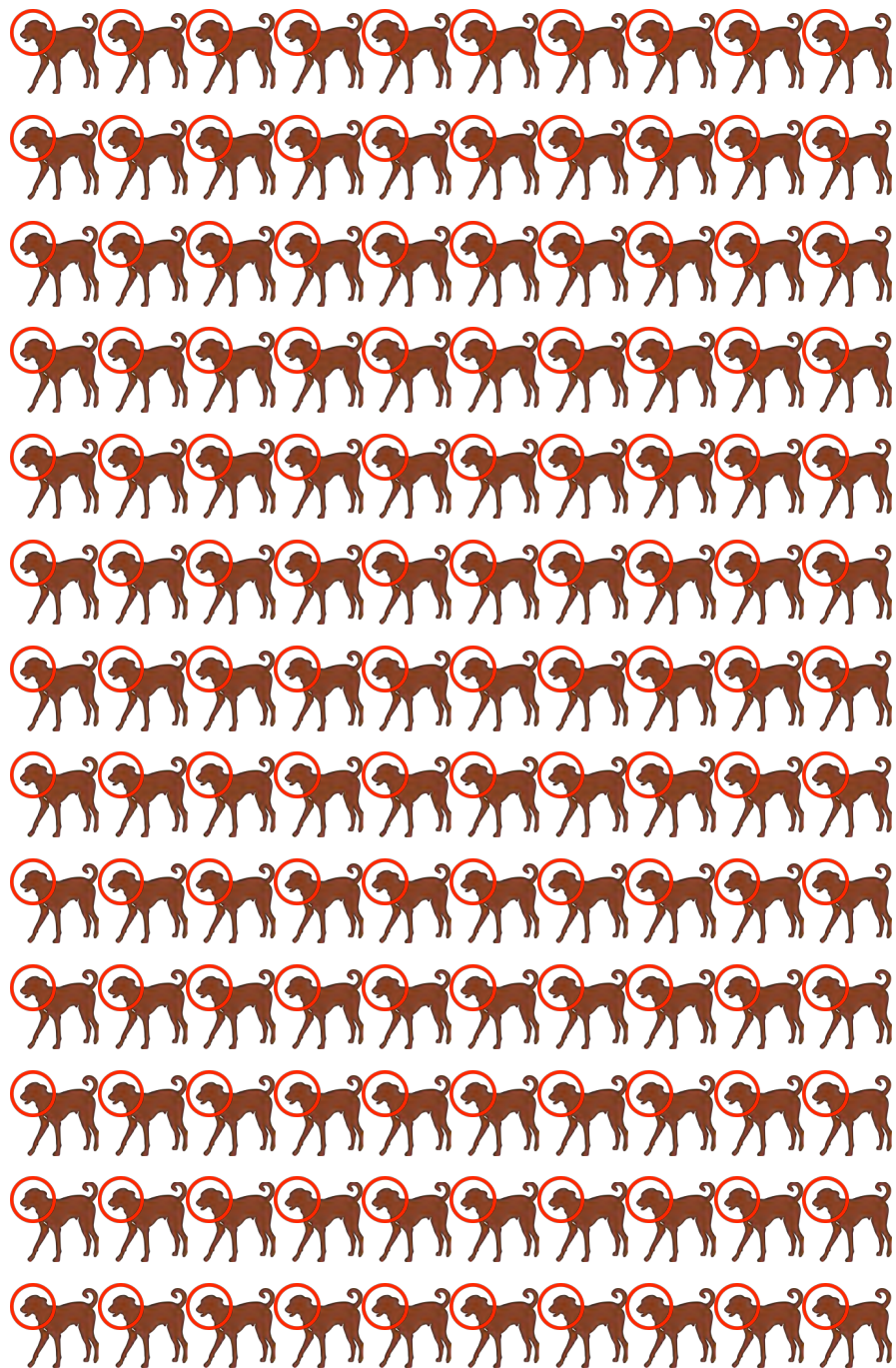
Arthritis

and more ...

So why study dogs instead of humans?

**“Mapping” genes:
Which genes are different?**

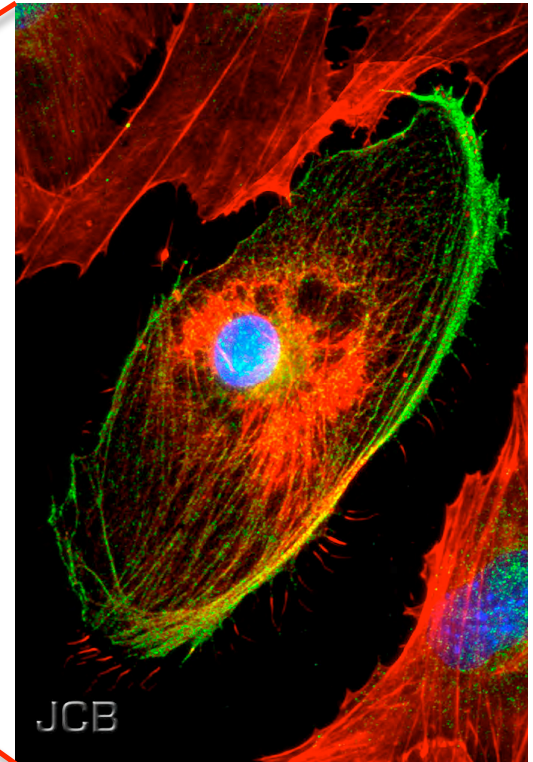


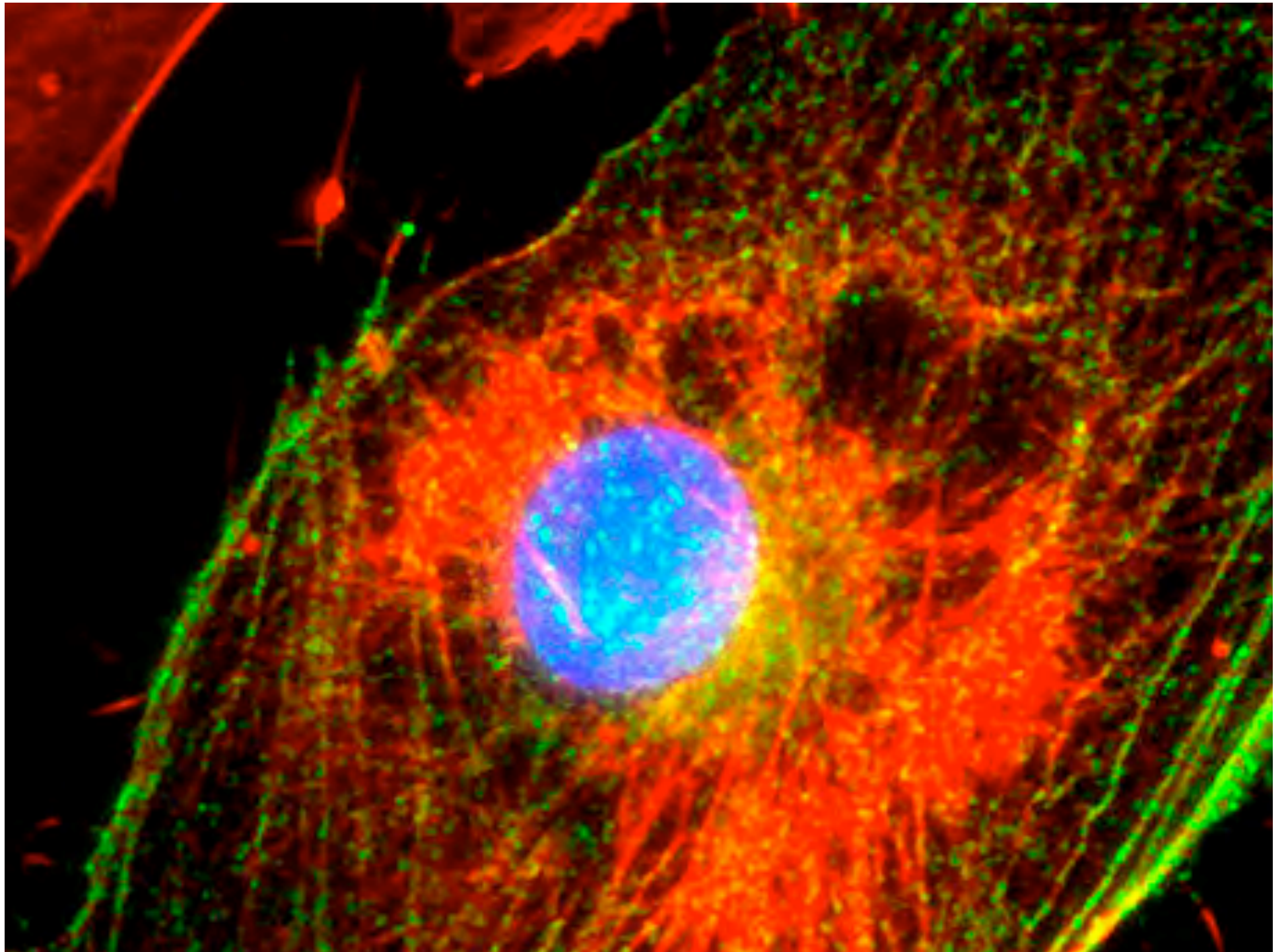


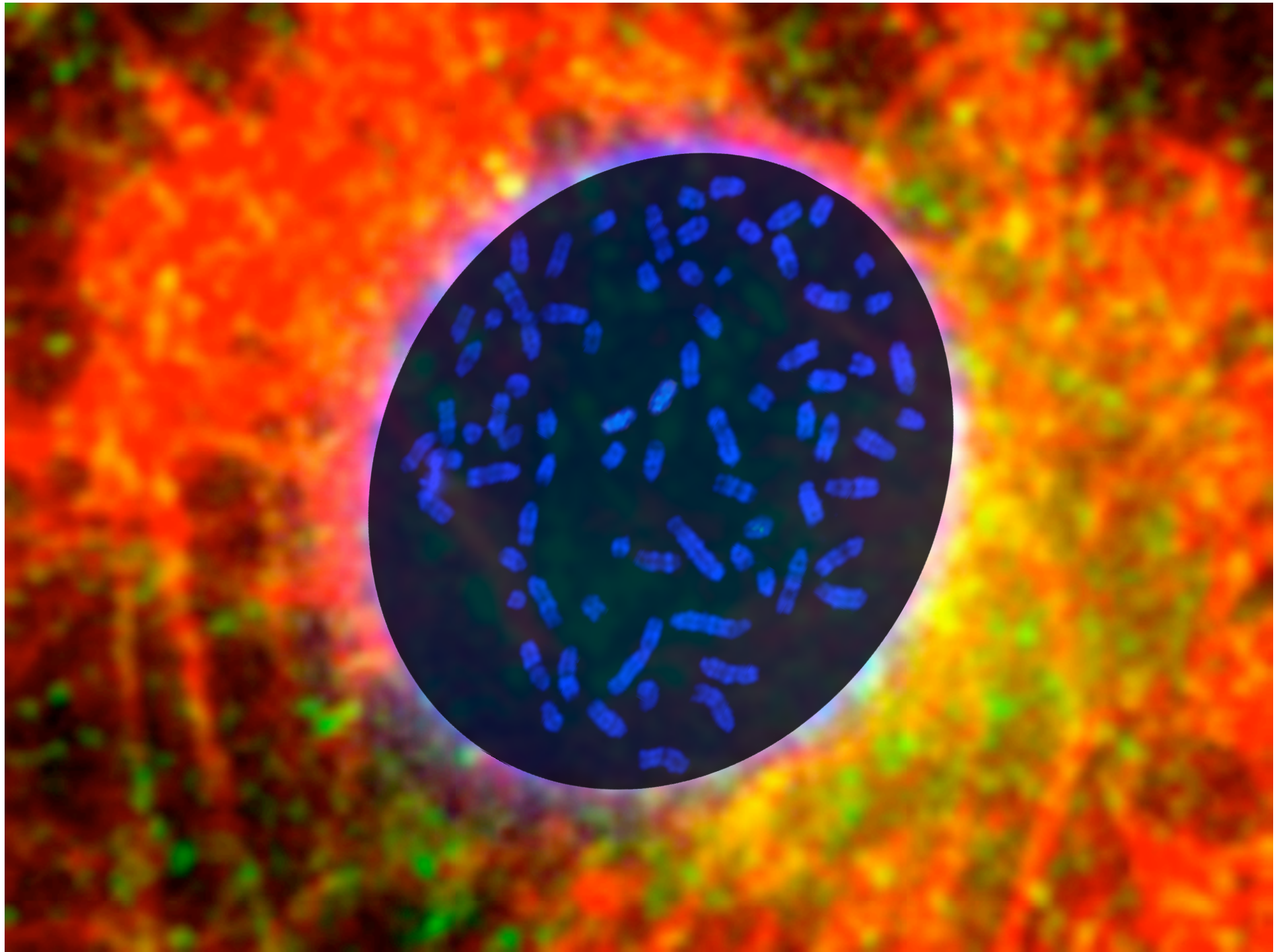


(c) Sundaresh Ramanathan

<http://www.smugmug.com>







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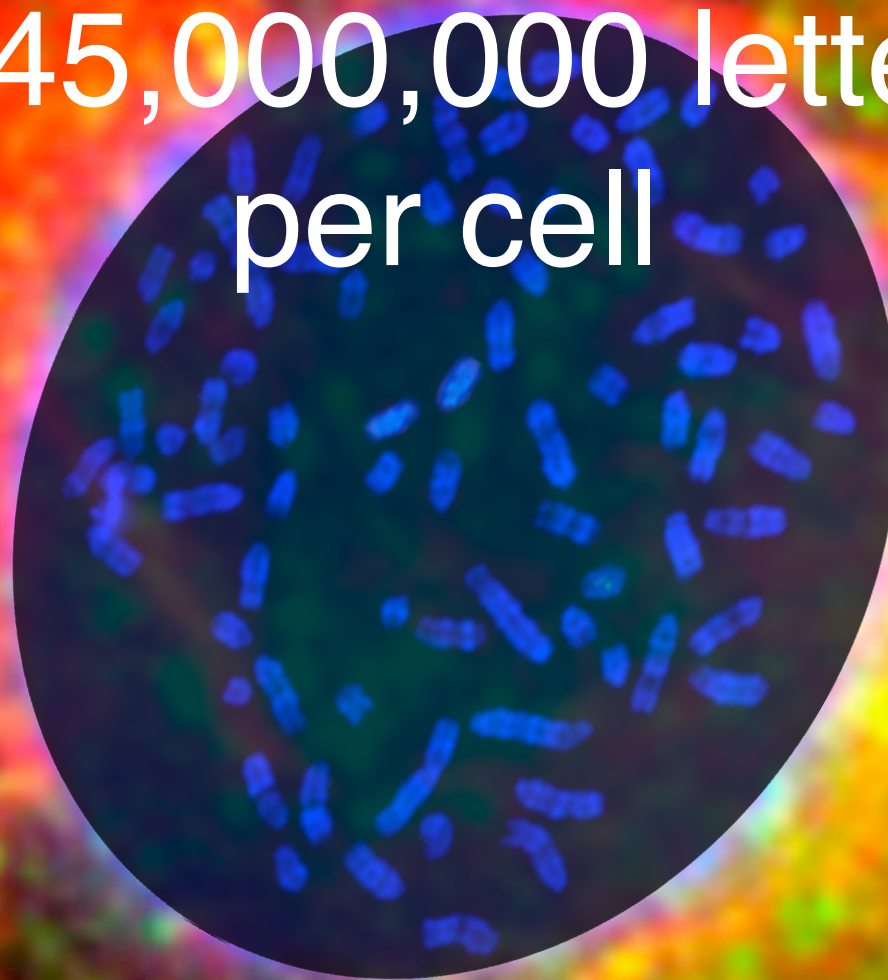
SNP

SNP

How many letters of DNA do you think make up all the DNA in the nucleus of one dog cell nucleus?


What percentage of those letters do you think would be different if you compared the DNA from two dogs of the same breed?

2,445,000,000 letters
per cell






1 change (SNP)
per
1600 letters



About 1,500,000 differences
between two dogs in the same breed



1 change (SNP)
per
1600 letters



We can map genes by testing about
1 in 10 changes (170,000 SNPs)

Let's map a gene!



sometimes
deaf



vs.



- 1) Collect blood sample
- 2) Extract DNA
- 3) Put DNA on chip to measure SNPs
- 4) Put chip on scanner
- 5) Analyze data

Liquid handler

- 1) Collect blood sample
- 2) Extract DNA
- 3) Put DNA on chip to measure SNPs
- 4) Put chip on scanner
- 5) Analyze data

Genotyping machine robot

- 1) Collect blood sample
- 2) Extract DNA
- 3) Put DNA on chip to measure SNPs
- 4) Put chip on scanner
- 5) Analyze data



... C A C G A T **T** C G A T G A A C G T ...
... C A C G A T **T** C G A T G G A C G T ...
... C A C G A T **T** C G A T G G A C G T ...
... C A C G A T **T** C G A T G G A C G T ...



... C A C G A T **A** C G A T G G A C G T ...
... C A C G A T **A** C G A T G A A C G T ...
... C A C C A T **A** C G A T G A A C G T ...
... C A C G A T **A** C G A T G A A C G T ...



100% Correlated SNP



... C A C G A T T C G A T G **A** A C G T ...

... C A C G A T T C G A T G **G** A C G T ...

... C A C G A T T C G A T G **G** A C G T ...

... C A C G A T T C G A T G **G** A C G T ...



... C A C G A T A C G A T G **G** A C G T ...

... C A C G A T A C G A T G **A** A C G T ...

... C A C C A T A C G A T G **A** A C G T ...

... C A C G A T A C G A T G **A** A C G T ...



Somewhat correlated SNP

Fill in empty boxes with what you might expect to find.

<i>Dog</i>	Position #1: 100% correlated to coat color	Position #2: Not correlated to coat color	Position #3: Somewhat correlated to coat color
<i>i</i> (white)	A	T	G
<i>ii</i> (white)			
<i>iii</i> (white)	A	T	G
<i>iv</i> (white)			
<i>v</i> (solid)	G	G	C
<i>vi</i> (solid)			
<i>vii</i> (solid)	G	G	C
<i>viii</i> (solid)			

Fill in empty boxes with what you might expect to find.

<i>Dog</i>	Position #1: 100% correlated to coat color	Position #2: Not correlated to coat color	Position #3: Somewhat correlated to coat color
<i>i</i> (white)	A	T	G
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<i>iii</i> (white)	A	T	G
<i>iv</i> (white)			
<i>v</i> (solid)	G	G	C
<i>vi</i> (solid)			
<i>vii</i> (solid)	G	G	C
<i>viii</i> (solid)			

Fill in empty boxes with what you might expect to find.

<i>Dog</i>	Position #1: 100% correlated to coat color	Position #2: Not correlated to coat color	Position #3: Somewhat correlated to coat color
<i>i</i> (white)	A	T	G
<i>ii</i> (white)	A		
<i>iii</i> (white)	A	T	G
<i>iv</i> (white)	A		
<i>v</i> (solid)	G	G	C
<i>vi</i> (solid)	G		
<i>vii</i> (solid)	G	G	C
<i>viii</i> (solid)	G		

Fill in empty boxes with what you might expect to find.

<i>Dog</i>	Position #1: 100% correlated to coat color	Position #2: Not correlated to coat color	Position #3: Somewhat correlated to coat color
<i>i</i> (white)	A	T	G
<i>ii</i> (white)	A	G	
<i>iii</i> (white)	A	T	G
<i>iv</i> (white)	A	G	
<i>v</i> (solid)	G	G	C
<i>vi</i> (solid)	G	T	
<i>vii</i> (solid)	G	G	C
<i>viii</i> (solid)	G	T	

Fill in empty boxes with what you might expect to find.

<i>Dog</i>	Position #1: 100% correlated to coat color	Position #2: Not correlated to coat color	Position #3: Somewhat correlated to coat color
<i>i</i> (white)	A	T	G
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<i>iii</i> (white)	A	T	G
<i>iv</i> (white)	A	G	G
<i>v</i> (solid)	G	G	C
<i>vi</i> (solid)	G	T	C
<i>vii</i> (solid)	G	G	C
<i>viii</i> (solid)	G	T	G

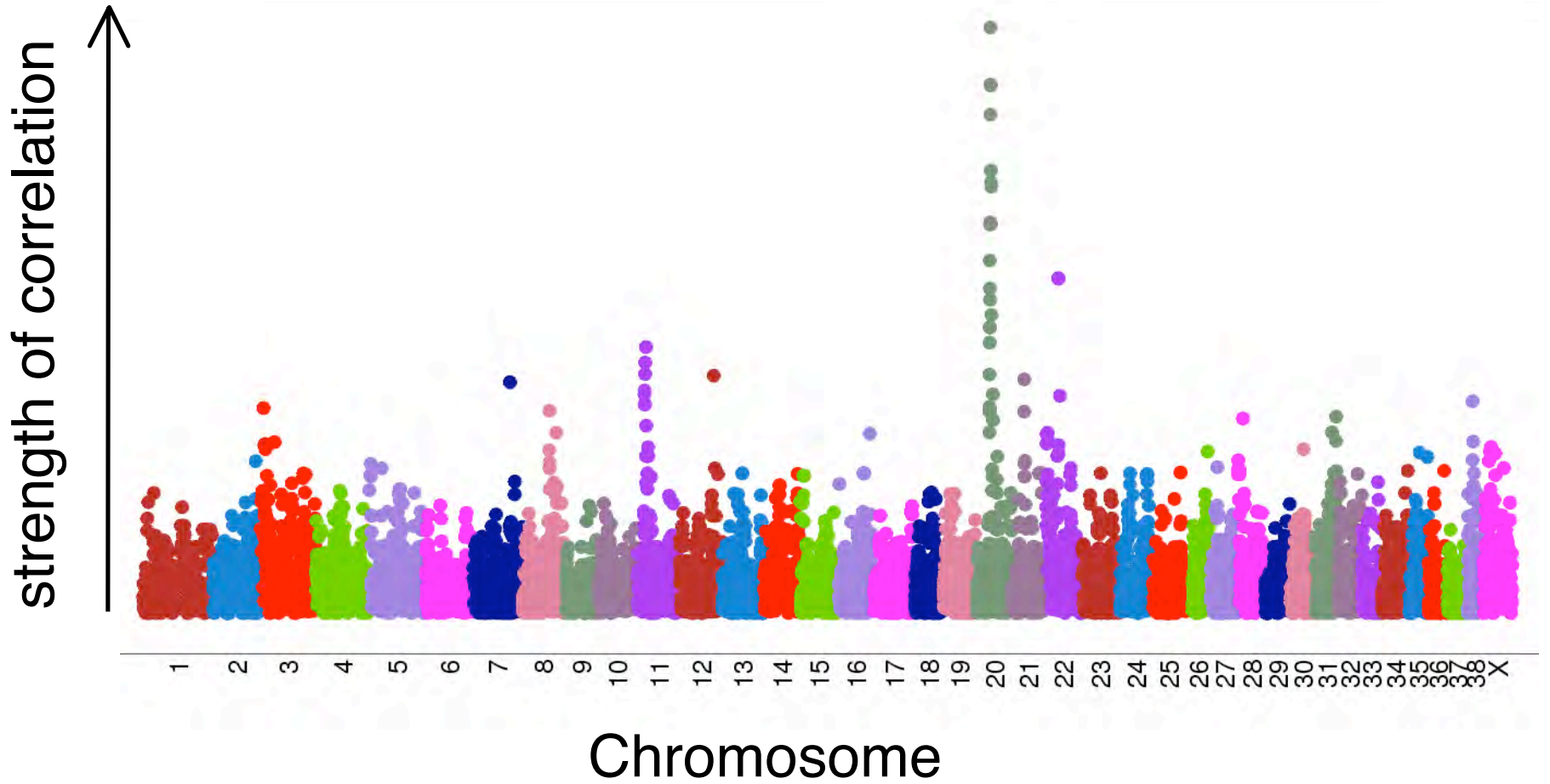
**High
Score**

**Low
Score**

**Intermediate
Score**

PLINK

Genome-wide mapping



	position on chromosome 20 (kb)									
	23,291,835	23,977,848	24,252,239	24,320,510	24,827,321	24,876,053	24,992,128	25,648,155	25,950,706	27,425,389
Pair #1	T		T	C	G	G				C
Pair #2		A	T	C		G	G			
Pair #3		A	T	C	G	G	G			
Pair #4			T	C	G	G	G	C	C	T
Pair #5		A	T	C	G	G	G	C	C	T
Pair #6					G	G	G	C	C	T
Pair #7			T	C	G	G	G			C
Pair #8	C	A			G	G	G	C	C	
Pair #9		G	G		G	G	G			
Pair #10					G	G	G	C	T	C
Pair #11	T	G			G	G	G	C	C	T
Pair #12		A	T	C	G	G	G		C	T
Pair #13		G	G		G	G	G			
Pair #14					G	G	G	C		
Pair #15	T	G	T	C	G	G				

	position on chromosome 20 (kb)									
	23,291,835	23,977,848	24,252,239	24,320,510	24,827,321	24,876,053	24,992,128	25,648,155	25,950,706	27,425,389
Pair #1	T		T	C	G	G				C
Pair #2		A	T	C		G	G			
Pair #3		A	T	C	G	G	G			
Pair #4			T	C	G	G	G	C	C	T
Pair #5		A	T	C	G	G	G	C	C	T
Pair #6					G	G	G	C	C	T
Pair #7			T	C	G	G	G			C
Pair #8	C	A			G	G	G	C	C	
Pair #9		G	G		G	G	G			
Pair #10					G	G	G	C	T	C
Pair #11	T	G			G	G	G	C	C	T
Pair #12		A	T	C	G	G	G		C	T
Pair #13		G	G		G	G	G			
Pair #14					G	G	G	C		
Pair #15	T	G	T	C	G	G				

position on chromosome 20 (kb)									
23,291,835	23,977,848	24,252,239	24,320,510	24,827,321	24,876,053	24,992,128	25,648,155	25,950,706	27,425,389

Chromosome 20 between letters 24,827,321 and 24,992,128

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23,291,835	23,977,848	24,252,239	24,320,510	24,827,321	24,876,053	24,992,128	25,648,155	25,950,706	27,425,389

Chromosome 20 between letters 24,827,321 and 24,992,128

... mutations in the this gene cause auditory-pigmentary syndromes

We mapped the gene: MITF!



sometimes
deaf