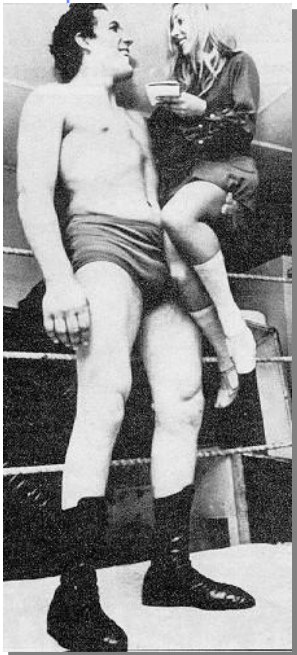


Beyond Mendel's Laws of Inheritance

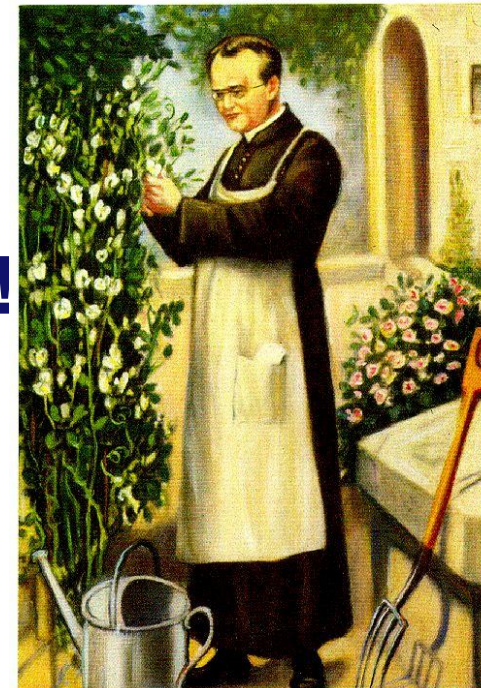
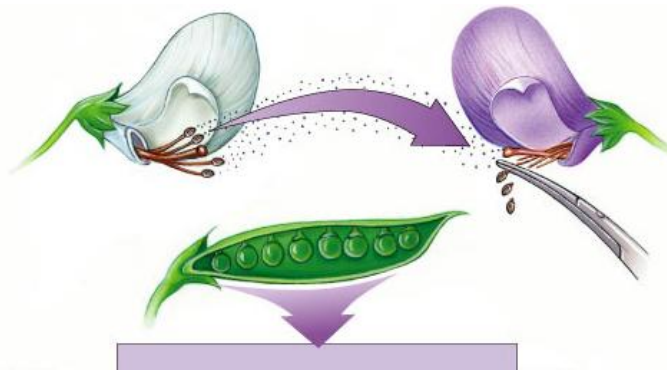
Section 11.3

Mrs. Michaelson



Extending Mendelian genetics

- Mendel worked with a simple system
 - ◆ peas are genetically simple
 - ◆ most traits are controlled by single gene
 - ◆ each gene has only 2 version
 - 1 completely dominant (A)
 - 1 recessive (a)
- But its usually not that simple!



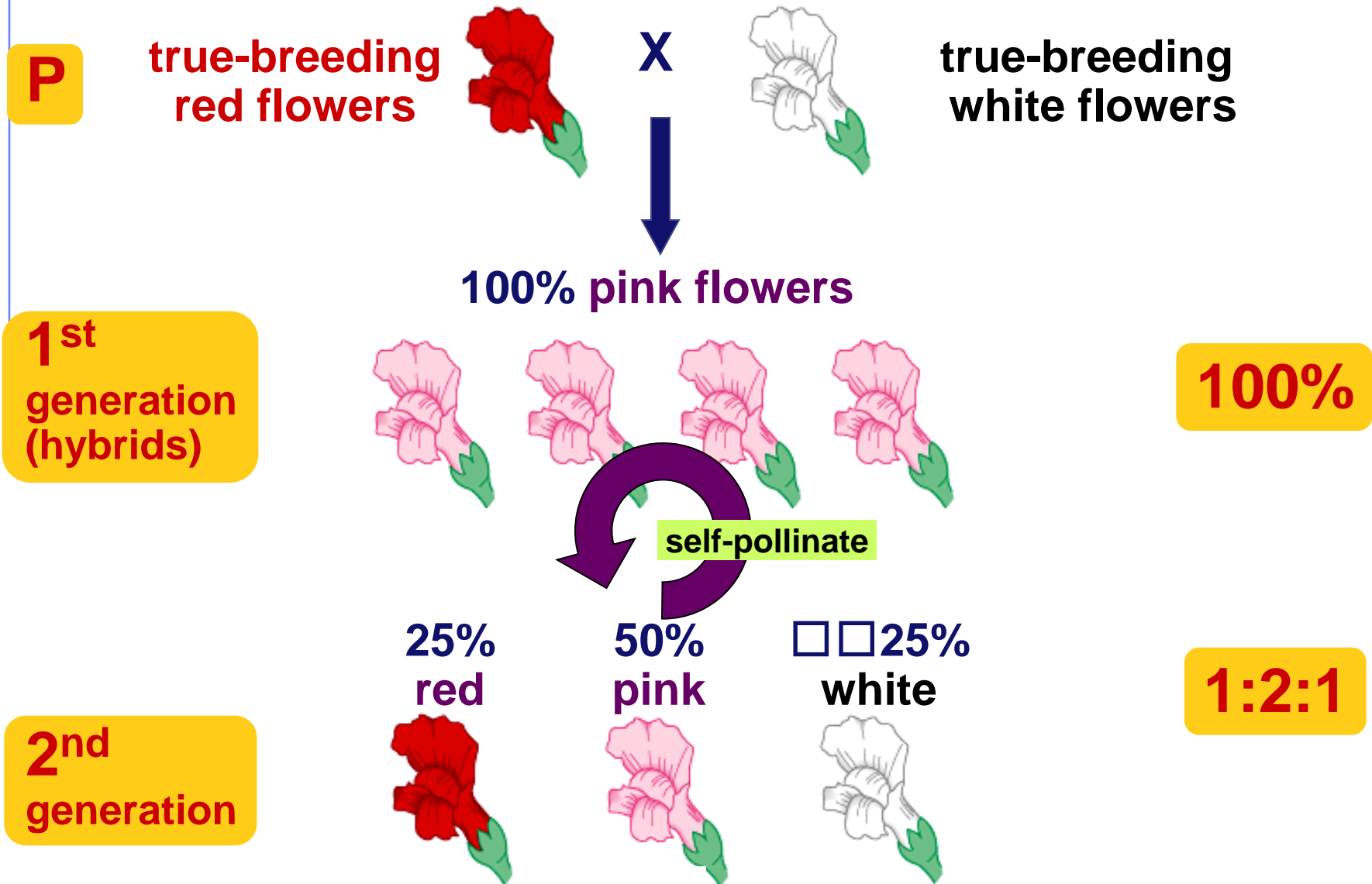
Gregor Mendel

Incomplete dominance

- Hybrids have “in-between” appearance
 - RR = red flowers $\rightarrow RR$
 - rr = white flowers $\rightarrow R'R'$
 - Rr = pink flowers $\rightarrow RR'$
 - make 50% less color



Incomplete dominance



Incomplete dominance

RR' x RR'







male / sperm

R

R'

female / eggs
R
R'

RR 	RR' 
RR' 	$R'R'$ 

RR



%
genotype

25%

%
phenotype

25%

RR'



50%

50%

RR'



$R'R'$



25%

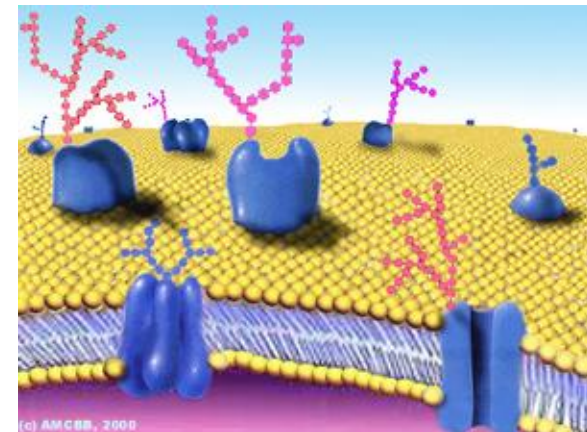
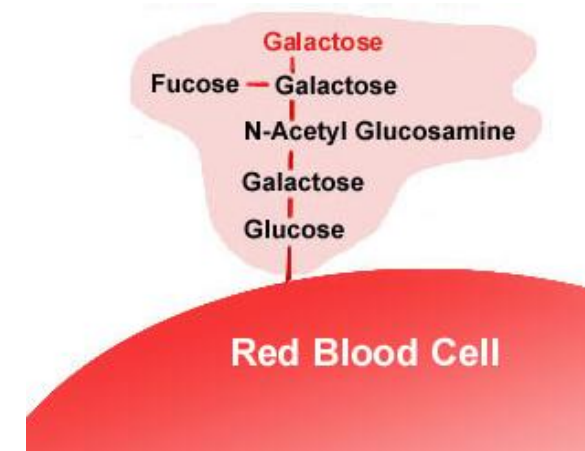
25%

1:2:1

1:2:1

Codominance

















- Equal dominance
 - ◆ human ABO blood groups
 - ◆ 3 version
 - A, B, i
 - A & B alleles are **codominant**
 - both A & B alleles are dominant over *i* allele
 - ◆ the genes code for different sugars on the surface of red blood cells
 - “name tag” of red blood cell



Genetics of Blood type

pheno- type	genotype	antigen on RBC	antibodies in blood	donation status
A		antigens on surface of RBC	antibodies	—
B		antigens on surface of RBC	antibodies	—
AB		antigens on surface of RBC	antibodies	
O		on surface of RBC	antibodies	

Blood donation

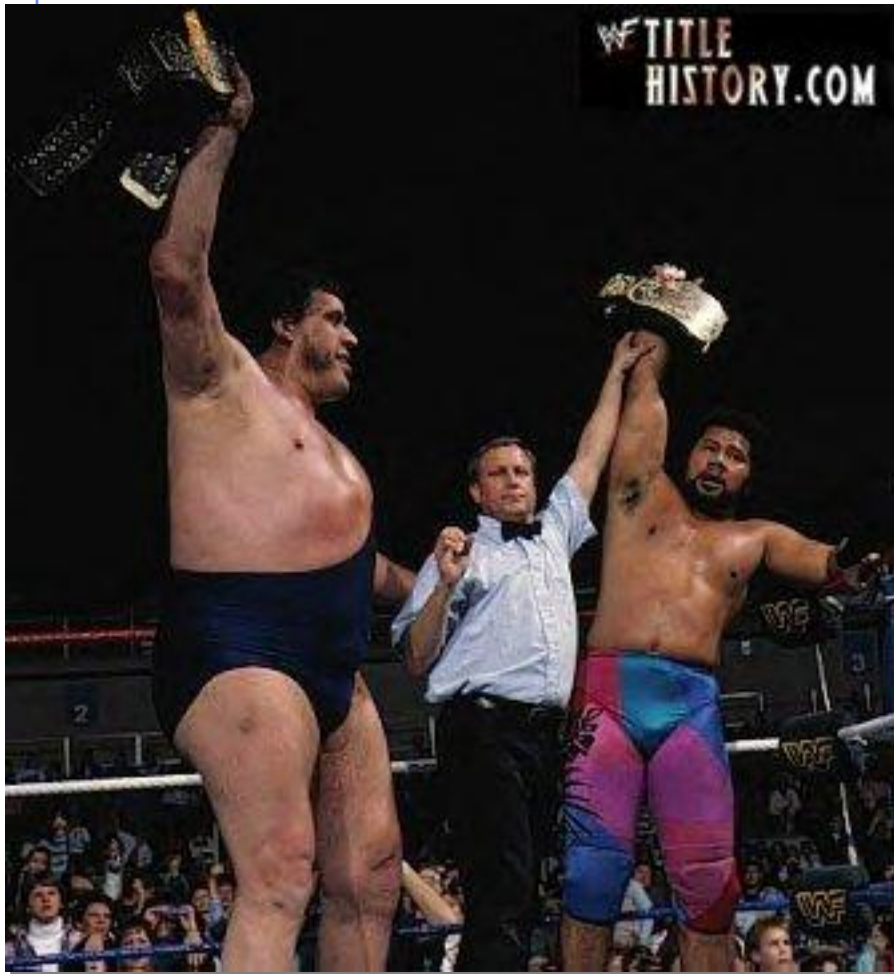
(a) Phenotype (blood group)	(b) Genotypes	(c) Antibodies present in blood serum	(d) Results from adding red blood cells from groups below to serum from groups at left			
			A	B	AB	O
A	$I^A I^A$ or $I^A i$	Anti-B				
B	$I^B I^B$ or $I^B i$	Anti-A				
AB	$I^A I^B$	—				
O	ii	Anti-A Anti-B				

One gene: many effects

- The genes that we have covered so far affect only one trait
- But most genes are affect many
 - ◆ 1 gene affects more than 1 trait
 - dwarfism (achondroplasia)
 - gigantism (acromegaly)



Acromegaly: André the Giant



Inheritance pattern of Achondroplasia



Aa x aa

a a

	a	a
A	Aa	Aa
a	aa	aa

50% dwarf:50% normal or 1:1



Aa x Aa

A a

	A	a
A	AA	Aa
a	Aa	aa

67% dwarf:33% normal or 2:1

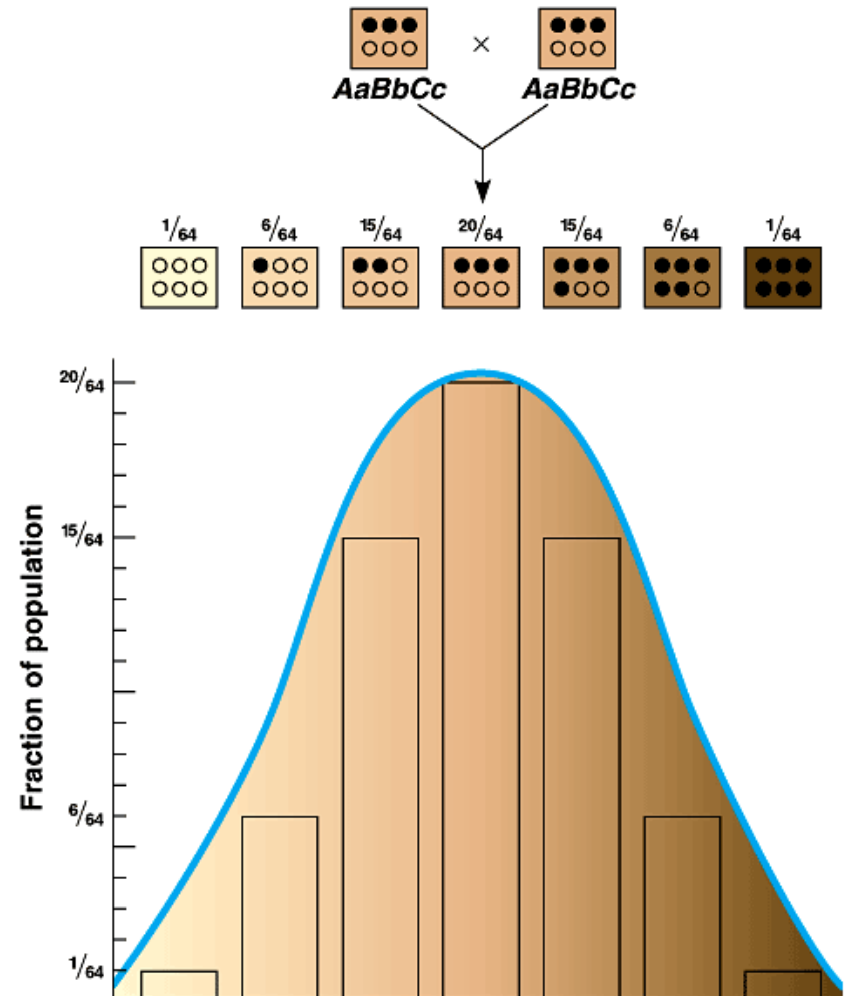
Many genes: one trait

- **Polygenic inheritance**
 - ◆ additive effects of many genes
 - ◆ humans
 - skin color
 - height
 - weight
 - eye color
 - intelligence
 - behaviors



Human skin color

- **AaBbCc x AaBbCc**
 - ◆ can produce a wide range of shades
 - ◆ most children = intermediate skin color
 - ◆ some can be very light & very dark



Albinism



albino
Africans



melanin = universal brown color



OCA1 albino

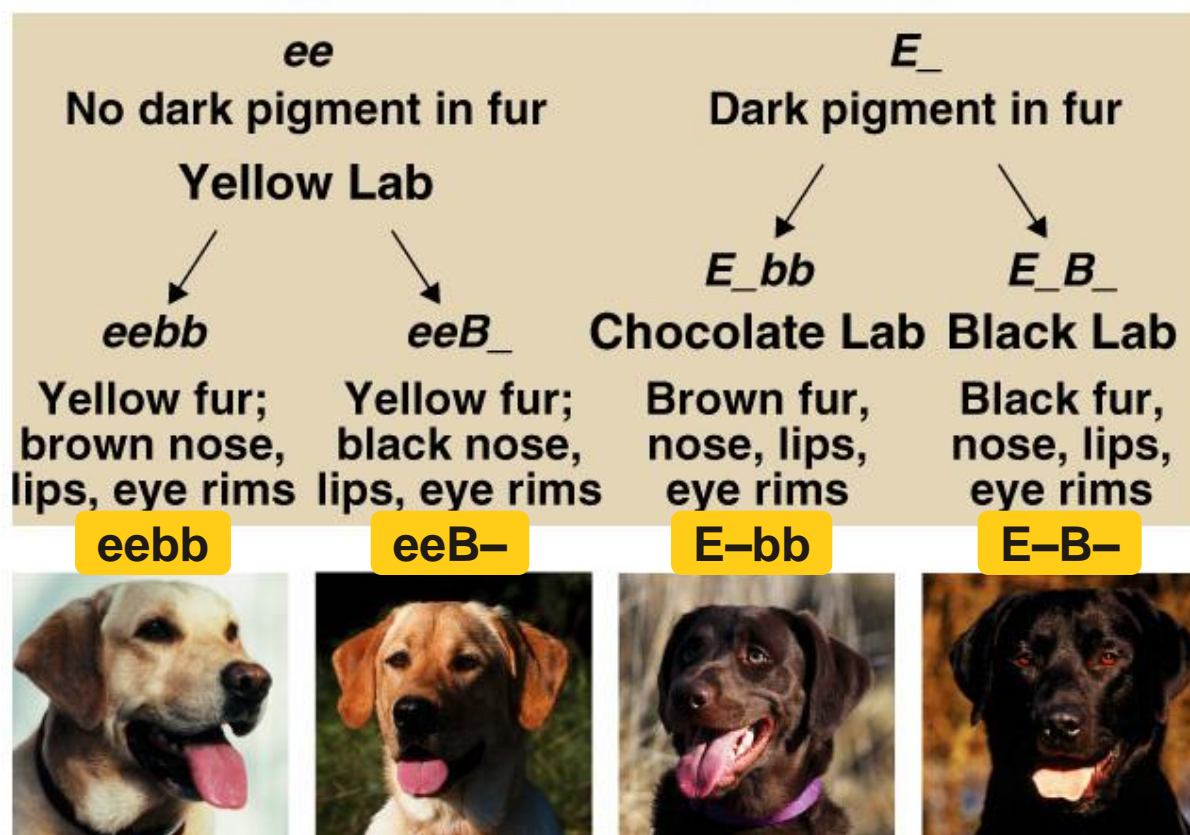


Bianca Knowlton



Coat color in other animals

- 2 genes: **E,e** and **B,b**
 - color (**E**) or no color (**e**)
 - how dark color will be: **black (B)** or **brown (b)**



Environment effect on genes

- Phenotype is controlled by both environment & genes

Human skin color is influenced by both genetics & environmental conditions



Color of Hydrangea flowers is influenced by soil pH

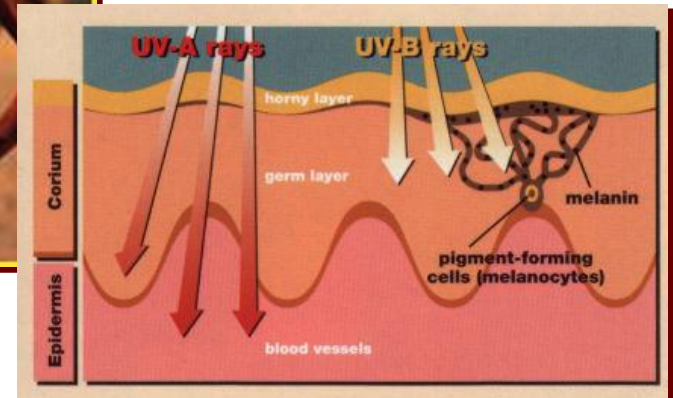
Coat color in arctic fox influenced by heat sensitive alleles



(a)

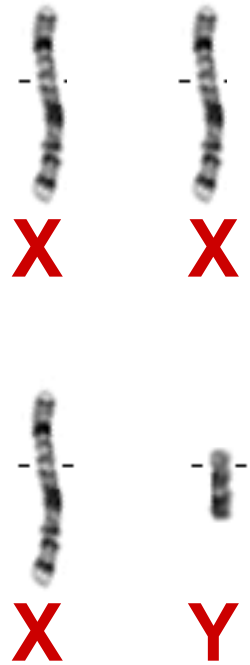


(b)

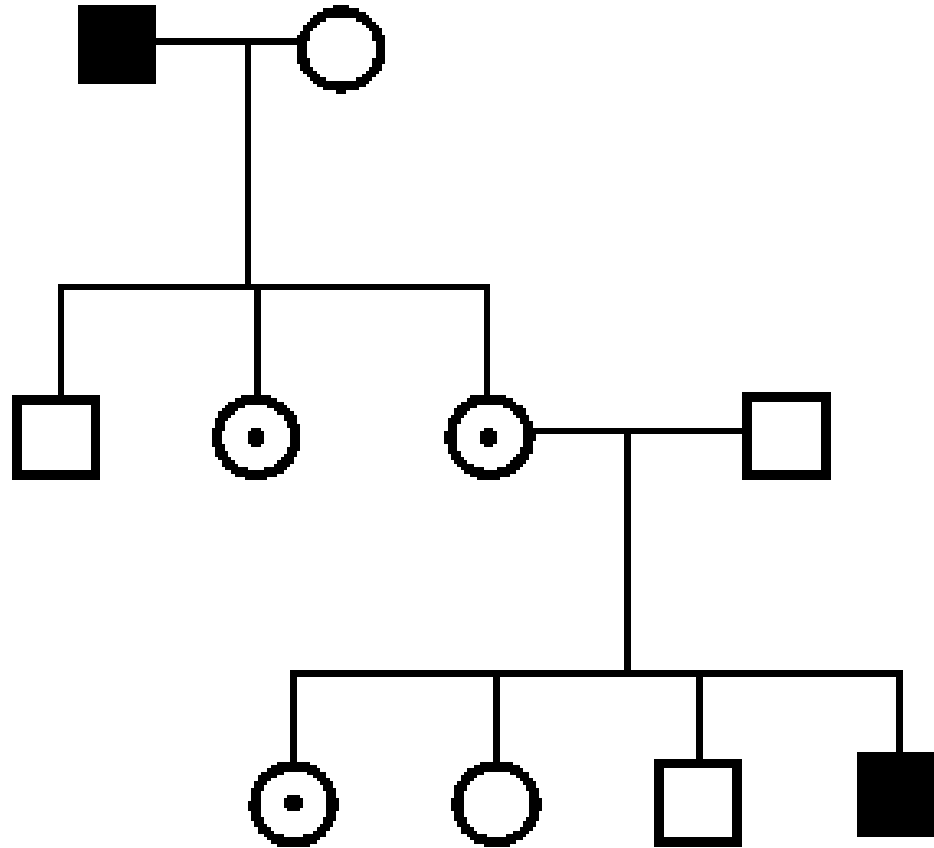


Genetics of sex

- Women & men are very different, but just a few genes create that difference
- In mammals = 2 sex chromosomes
 - ◆ X & Y
 - ◆ 2 X chromosomes = female: XX
 - ◆ X & Y chromosome = male: XY

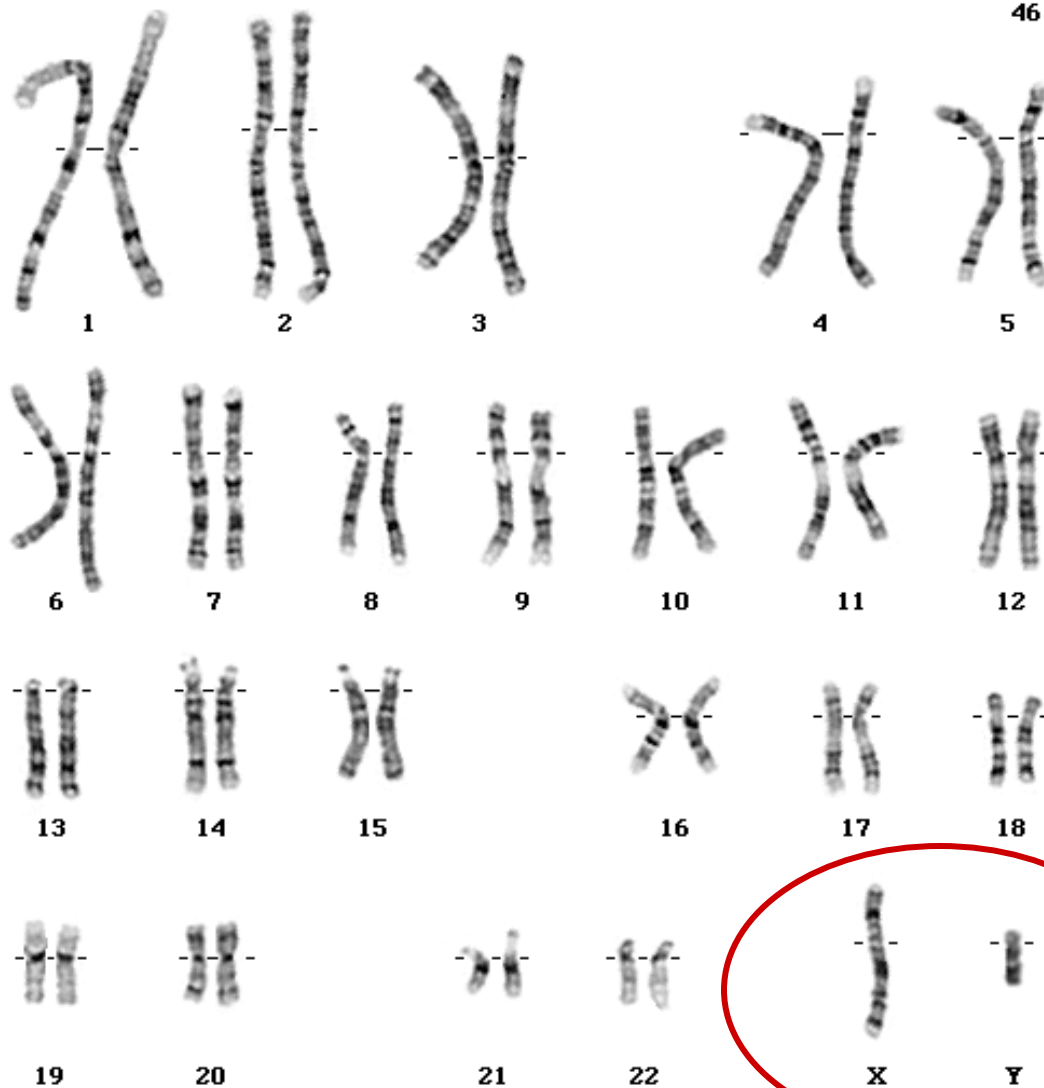


Pedigree for recessive allele

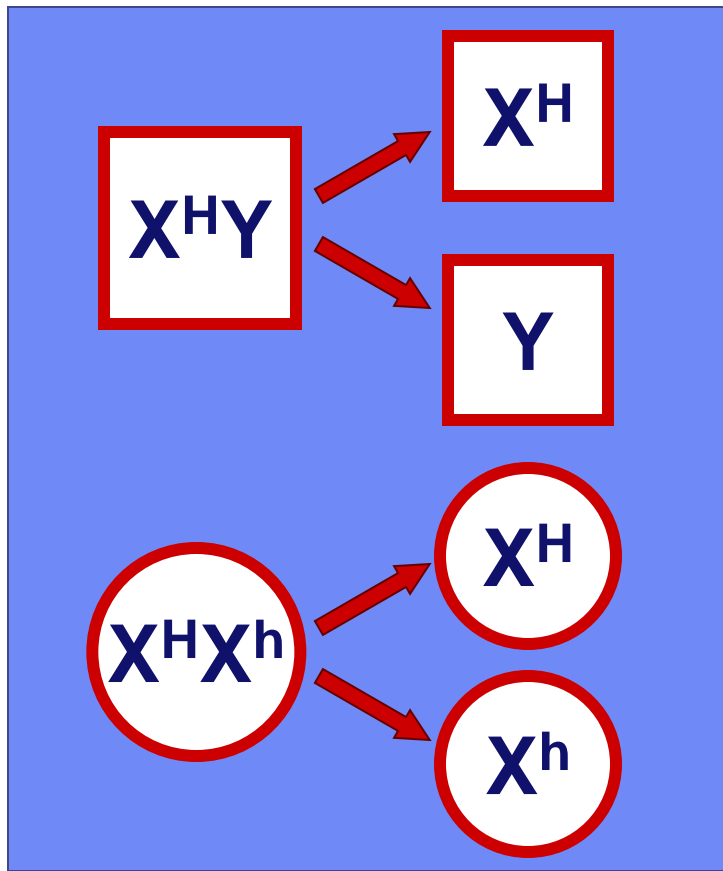
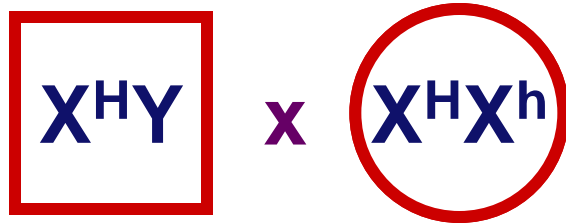


- only males affected
- males transmit trait to all daughters (carriers) but no sons
- female carriers transmit trait to 50% of offspring

Sex chromosomes

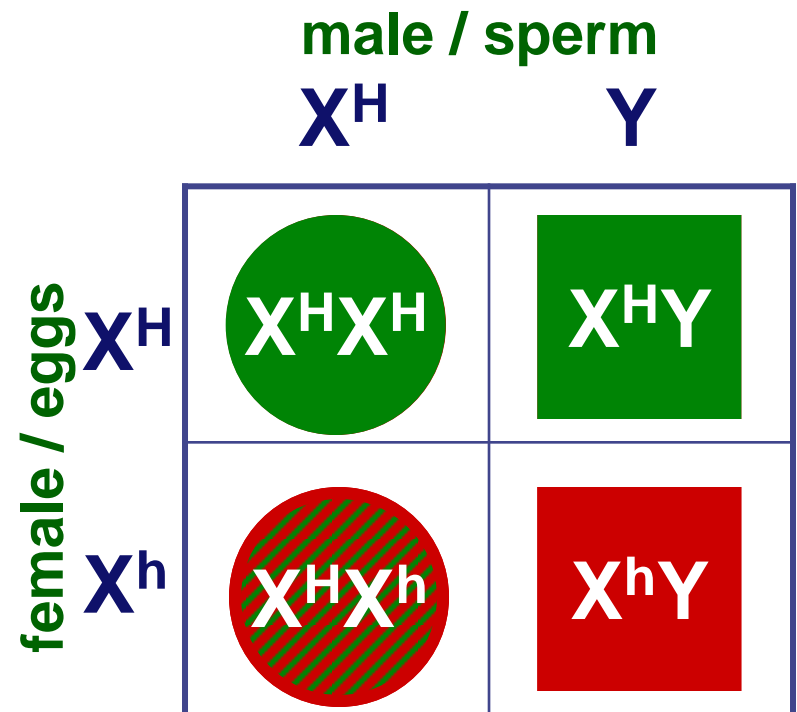


Sex-linked traits



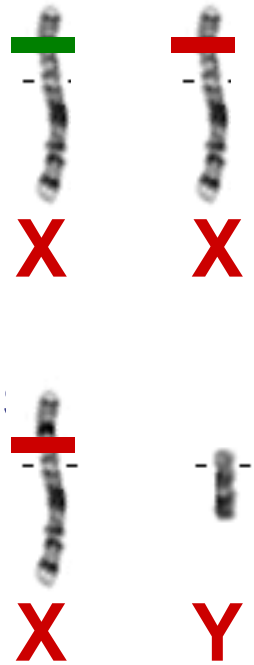
sex-linked recessive

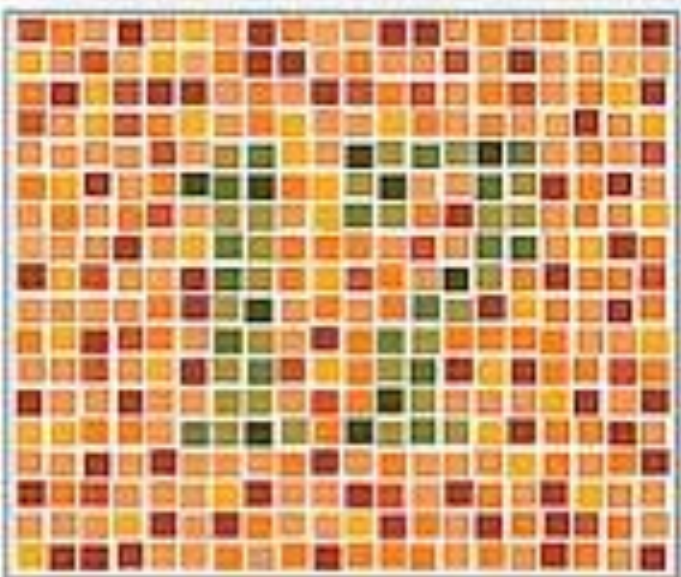
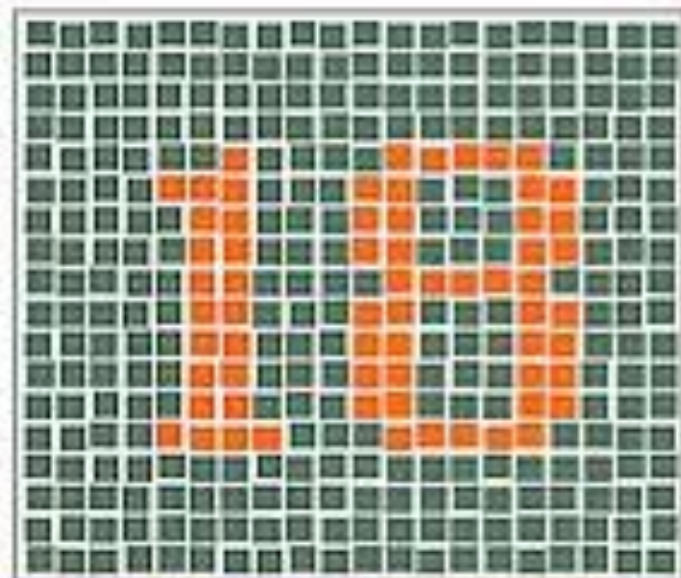
2 normal parents,
but mother is carrier



Sex-linked traits

- Sex chromosomes have other genes on them, too
 - ◆ *Drosophila* – fruit fly – inherits sex chromosomes the same as humans
 - ◆ especially the X chromosome
 - ◆ hemophilia in humans
 - blood doesn't clot
 - ◆ Duchenne muscular dystrophy in human
 - loss of muscle control
 - ◆ red-green color blindness
 - see green & red as shades of grey





Various tests for color blindness

Sex Linked Traits (cont.)

■ **Hemophilia A and B**

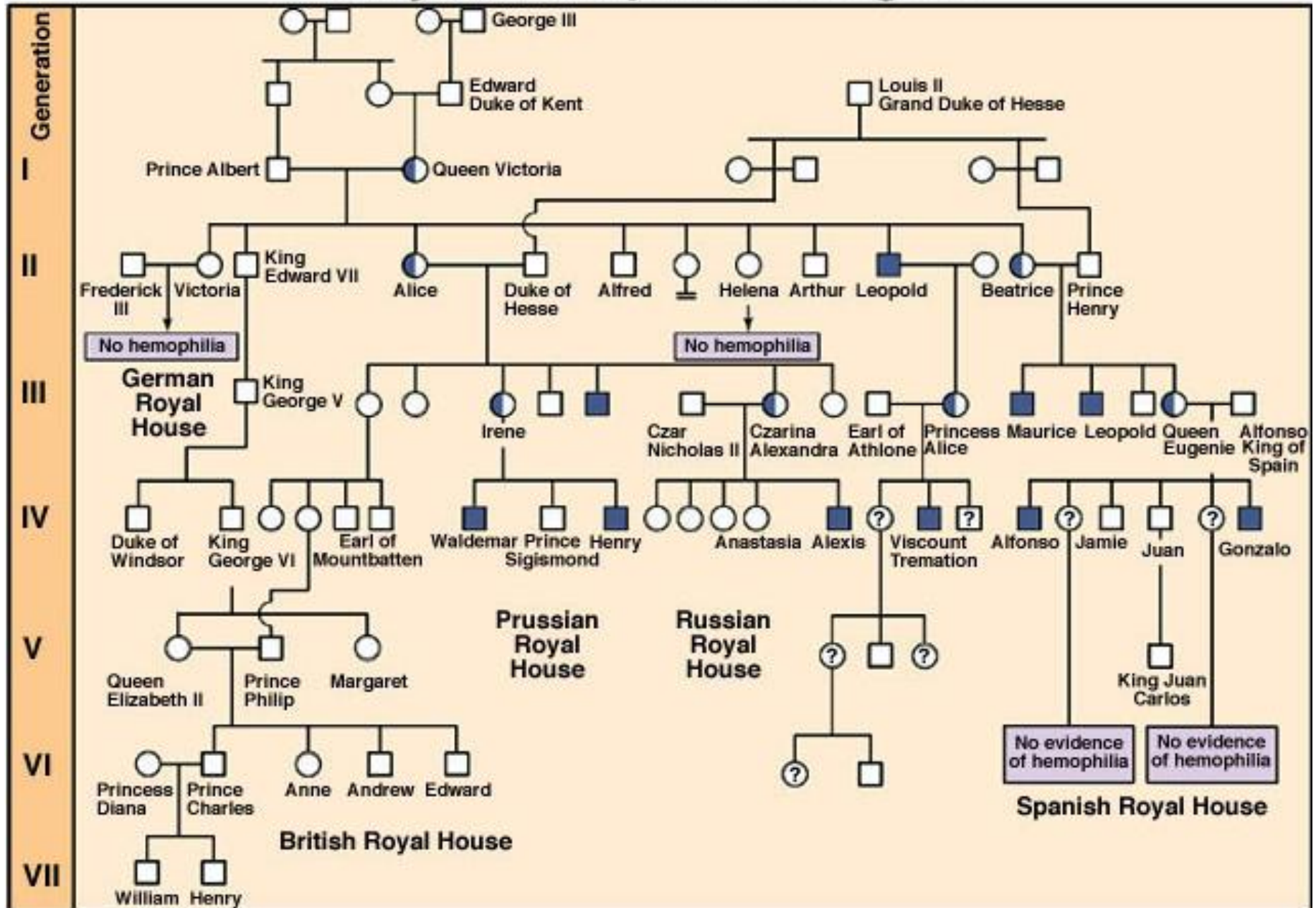
- ◆ **Blood does not clot (coagulate) normally and they continue to bleed.**
- ◆ **Internal bleeding most dangerous – brain, joints, muscles and tissues.**
- ◆ **Can be treated with blood transfusions and injections of Factor VIII (clotting enzyme).**

The “Royal Disease” - Hemophilia

- Queen Victoria (1819-1901) of Great Britain had a defective gene for Clotting Factor VIII, which caused "royal hemophilia" in her son Leopold. her daughters Beatrice and Alice were carriers.



Royal Hemophilia Pedigree



The “Royal Disease” (cont.)

- **Czar Nicholas II of Russia and his family, photographed c. 1916, showing his wife Alexandra (who was a carrier of hemophilia), his four daughters, and (in the foreground) his son Alexis, perhaps the most famous European royal with hemophilia.**



www.humanillnesses.com/.../Hemophilia.html



www.scienceclarified.com/.../scet_03_img0269.jpg

- **Alexis, son of Czar Nicholas II of Russia.**
- **Alexis was the heir to the Russian throne and circumstances surrounding his successful treatment for pain by the controversial monk Rasputin may have triggered the timing of the downfall of the Czarist regime in Russia and thus events subsequent to the Russian revolution.**

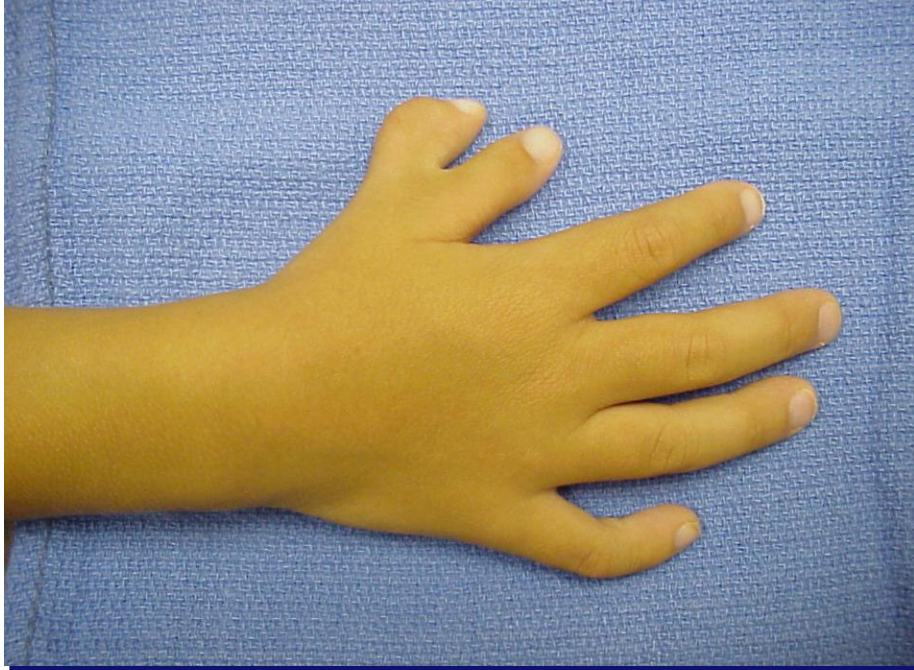
Dominant \neq most common allele

- Because an allele is dominant does **not** mean...
 - ◆ it is better, or
 - ◆ it is more common



Polydactyly
dominant allele

Polydactyly



individuals are born with extra fingers or toes

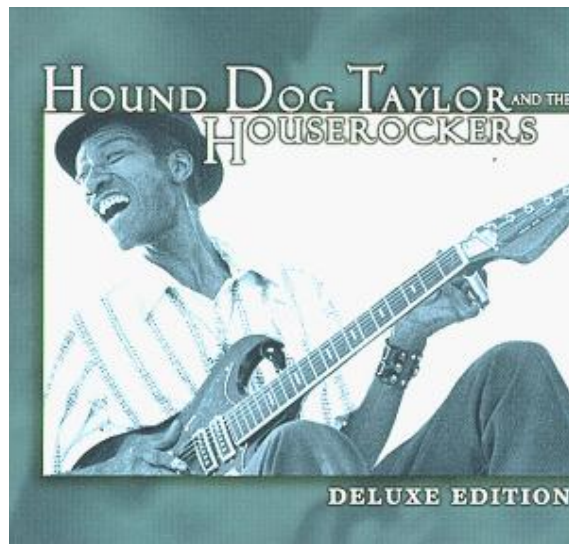
the allele for >5 fingers/toes is **DOMINANT** & the allele for 5 digits is **recessive**

recessive allele far **more common** than dominant

- only 1 individual out of 500 has more than 5 fingers/toes
- so 499 out of 500 people are homozygous recessive (aa)



Hound Dog Taylor





Any Questions?

