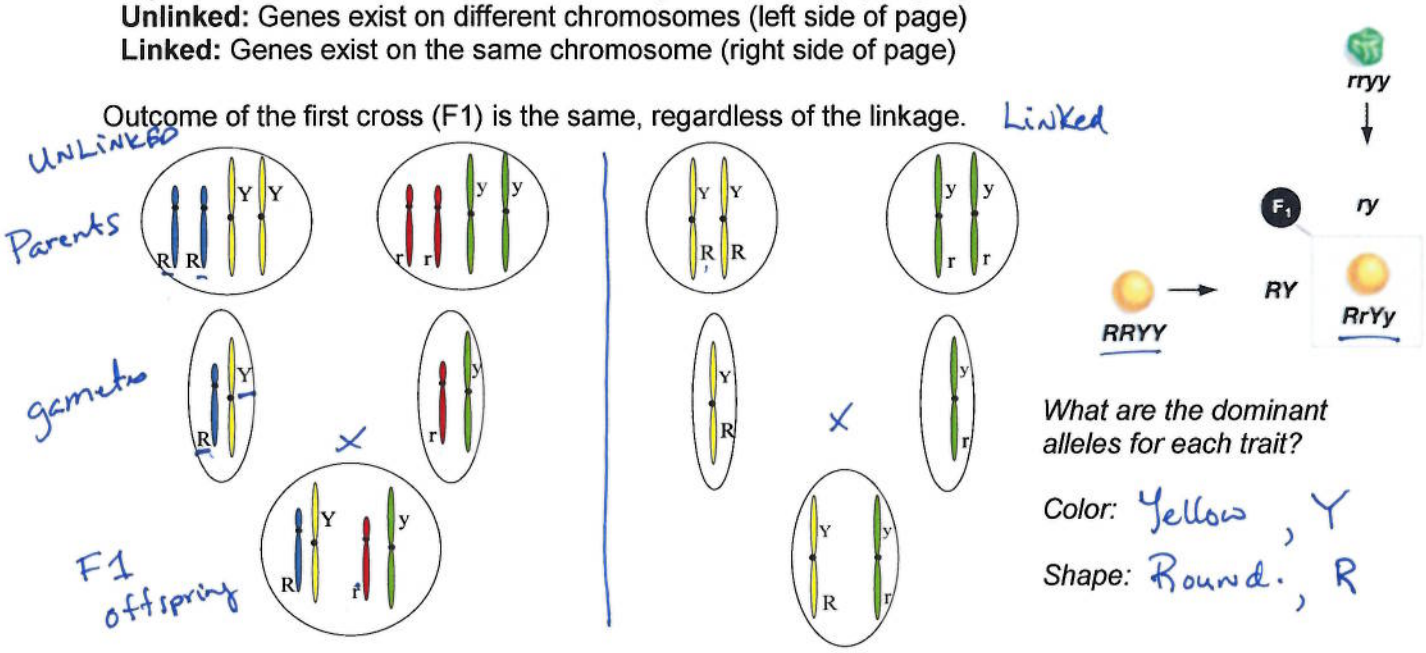
Lecture 35: Dihybrid cross, sex linkage, Co-dominate traits, Human Genetics

Dihybrid Cross: How do two different traits (color and shape) segregate?

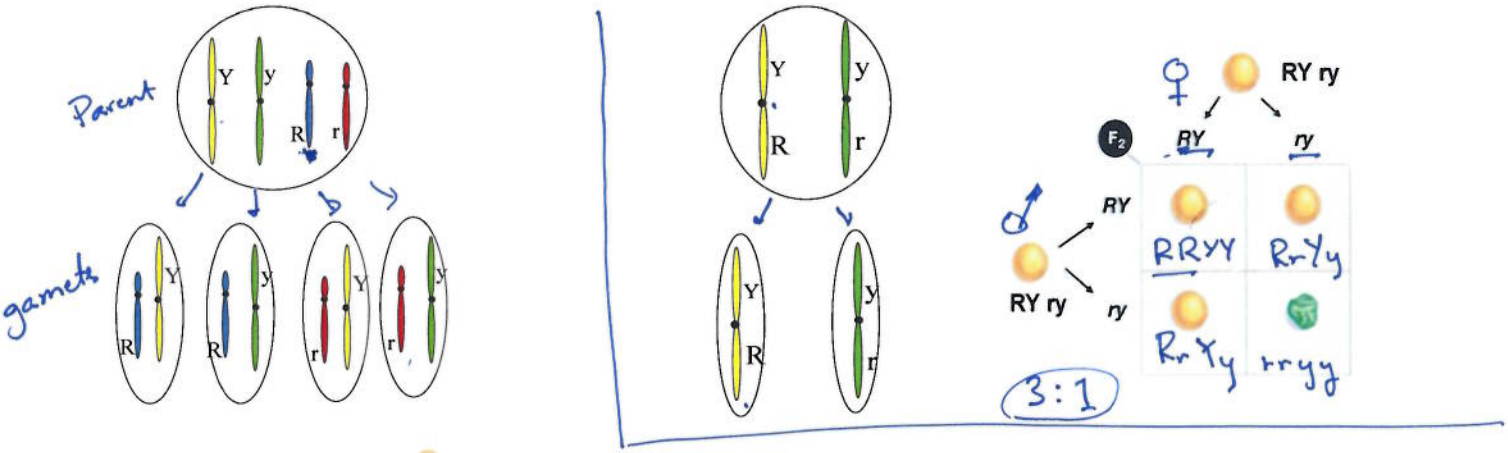
Unlinked: Genes exist on different chromosomes (left side of page)

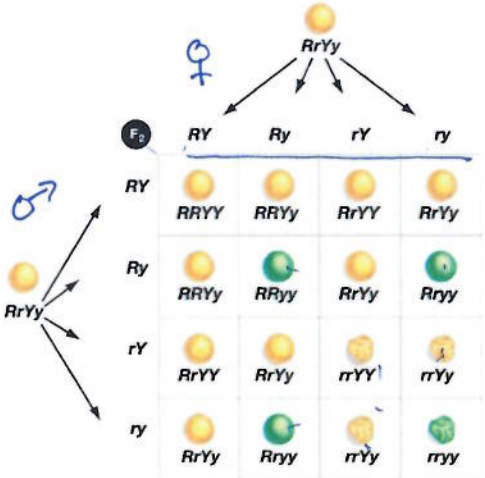
Linked: Genes exist on the same chromosome (right side of page)

Outcome of the first cross (F1) is the same, regardless of the linkage.



Outcome of the F1 x F1 will differ for unlinked (left) and linked (right):





Mendel observed:

315	108	101	32
predicted → phenotypes 9/16	3/16	3/16	1/16

Data most consistant with unlinked genes.

Summary of Rules:

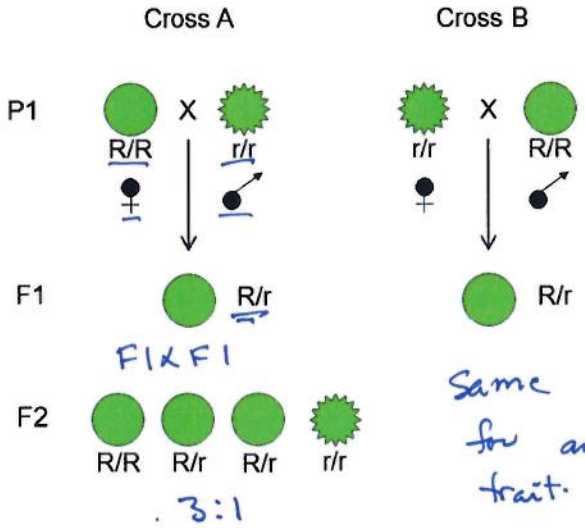
1. For one allelic pair, the alleles segregate equally into the gametes (50:50).
2. For unlinked genes, the segregation of one pair of alleles does not affect the other pair
3. Linked genes will segregate together. Crossing over can introduce new combinations of phenotypes.

Sex Linked Traits:

- Alleles *usually* found on the X-chromosome only – *why?*
- Observe different outcome in reciprocal crosses of homozygous parents.

Reciprocal cross – do two crosses, reversing the phenotypes of males and females.

- For genes on autosomal chromosomes the result is the same for both crosses and there is no dependence of the phenotype on the sex of the offspring→



Consider the following cross between fruit flies with different eye color:

red eyes ♀ x white eye ♂

F1 all red

F2 ¾ red, ¼ white 3:1

(However, all the white flies were male (♂) and the red flies were a mixture of male and female)

What is the dominant phenotype? Allele symbols? Red dominant. R, r (red, white.)

Reciprocal cross:

white eyes ♀ x red eye ♂

F1 all female flies are red, all male flies are white
F2 50% red, 50% white

These data cannot be explained by the model we used for autosomal chromosomes. let's assume that the gene is found on the X-chromosome and is not present on the Y chromosome.

First cross: The starting genotypes are: X^RX^R (♀) and X^rY (♂)

eggs: X^R × sperm: X^r *or* Y

F1: female flies: X^RX^r male flies: X^RY

F2:

X^RX^R : Red ♀
X^RY : Red ♂] 3
X^rX^R : Red ♀
X^rY : white ♂] 1

♂ \ ♀	X^R	X^r
X^R	X^RX^R	X^RX^r
Y	X^RY	X^rY

Second cross: The starting genotypes are: X^rX^r(♀) × X^RY(♂)

eggs: X^r × sperm: X^R *or* Y

F1: female flies: X^RX^r male flies: X^rY

F2:

X^RX^r : red female ♀] 1
X^RY : red ♂
X^rX^r : white ♀] 1
X^rY : white ♂

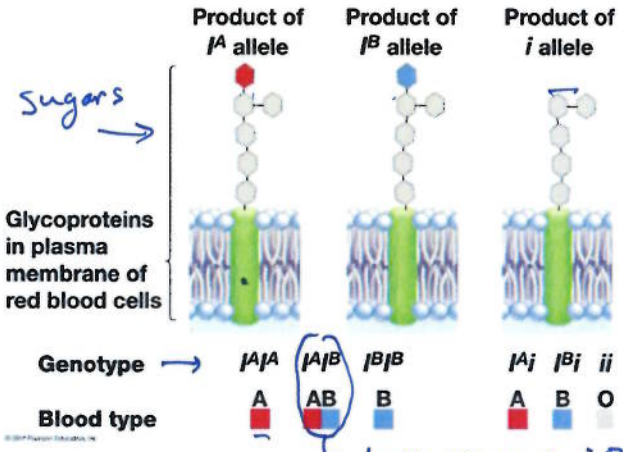
♂ \ ♀	X^R	X^r
X^r	X^RX^r	X^rX^r
Y	X^RY	X^rY

Codominance - phenotype of both alleles is observed.

Blood Types: Red blood cells are glycosylated, both on the lipids and the proteins. The enzyme that attaches the terminal sugar comes in three different alleles

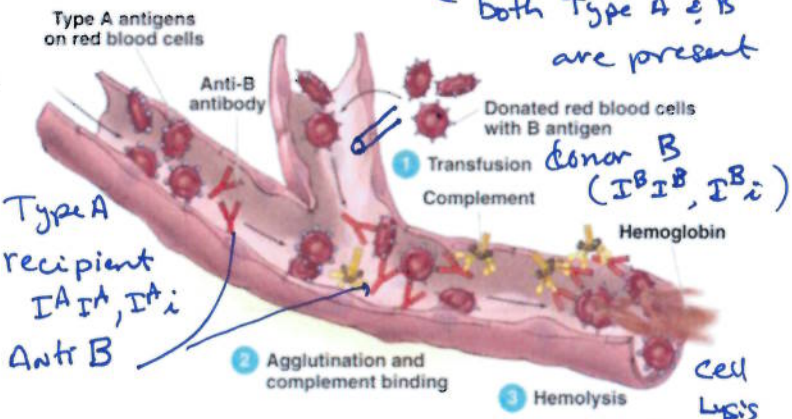
I^A – sugar A is attached
I^B- sugar B is attached
i – no sugar is attached.

Individuals inherit one allele from their mother and one from their father. Both alleles are expressed. Possible genotypes are shown on the right.



Blood Transfusions:

- These carbohydrates are antigens and can be recognized by antibodies.
- You don't make antibodies against your own blood group antigens.
- You have, almost from birth, pre-existing antibodies against the other blood types – these were made in response to common bacterial infections that produced antibodies that also recognize blood group antigens. The bacteria have similar carbohydrates.



- Incompatible transfusions occur when incoming (transfused) red blood cells encounter antibodies to their glycoproteins in the recipient, causing clumping of the incoming cells which leads to blockage of the blood vessels.
- Acceptable blood donors must not have antigens on the surface of their red cells that would interact with the preexisting antibodies present in the serum of the recipient.

Genotype	Phenotype (Blood type)	Ab present	Possible Donors
ii	O	A & B	O
I^Ai or I^AI^A	A	B	A O
I^Bi or I^BI^B	B	A	B O
I^AI^B	AB	none.	A, B, AB, O

Rh Factor – Another important blood group antigen.

- Two alleles are Rh^- and Rh^+.
- An Rh^- mother can produce anti-Rh antibodies, but does not normally make them because she is not exposed to the antigen until she carries an Rh^+ child.
- 1st child is Rh^+ - mother is exposed to Rh protein during *delivery*, makes antibodies. This child is not affected since they have been born before the mother could make antibodies.
- 2nd child is Rh^+ - antibodies from mother cross placenta, destroy red blood cells of fetus, causing anemia. at birth