

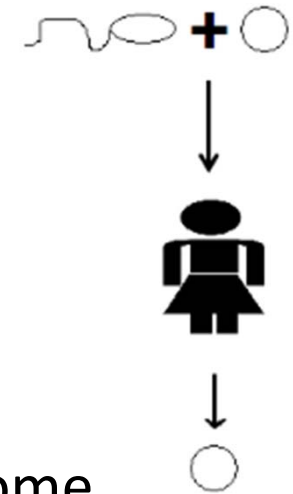


Recombination: Crossing over and gametes



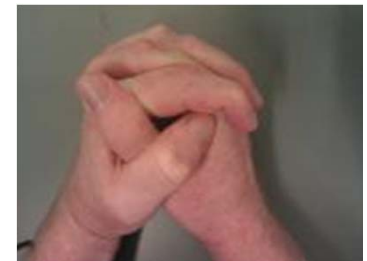
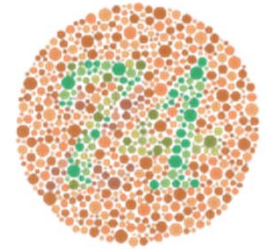
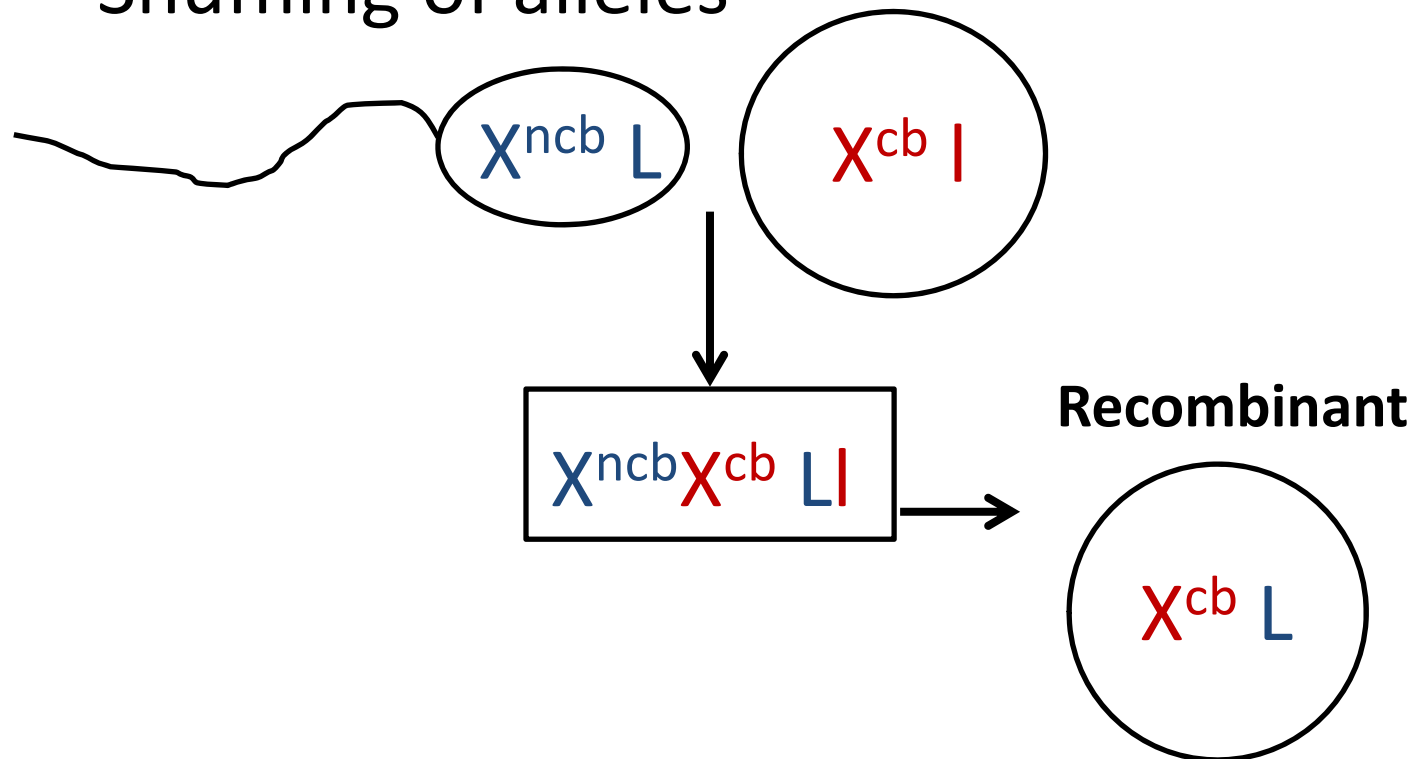
Recombination!

- Shuffling of alleles
 - Warning: *Wikipedia* definition is not precise
- Fundamental to genetics and evolution
- A gamete with a combination of alleles that did not come from the parents is a “recombinant” gamete
 - Examine by contrasting combinations of alleles at two stages:
 - Gametes *that made* person (from parents)
 - Gametes *from* person



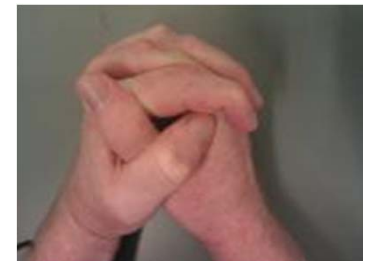
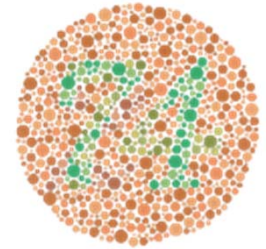
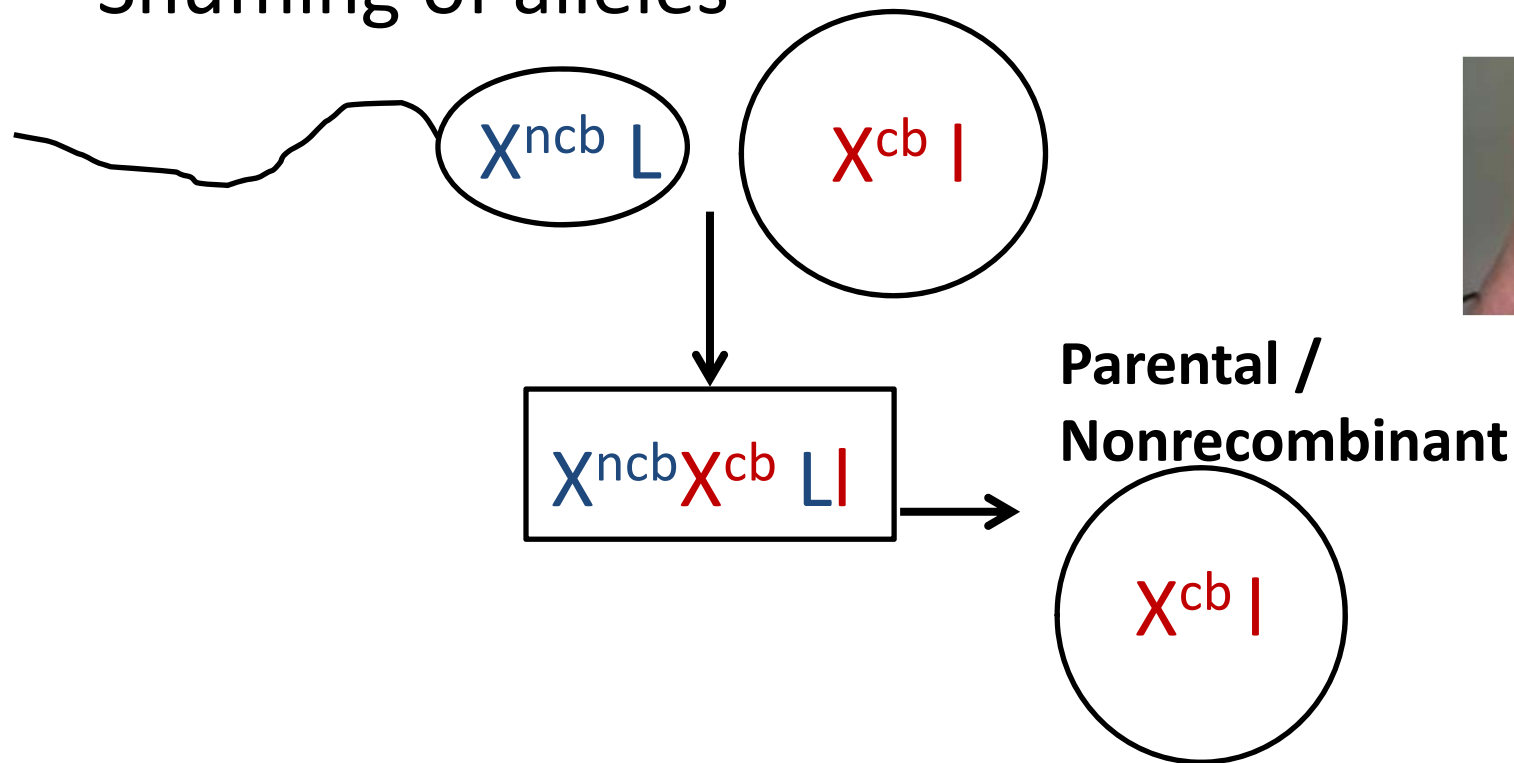
Recombination!

- Shuffling of alleles



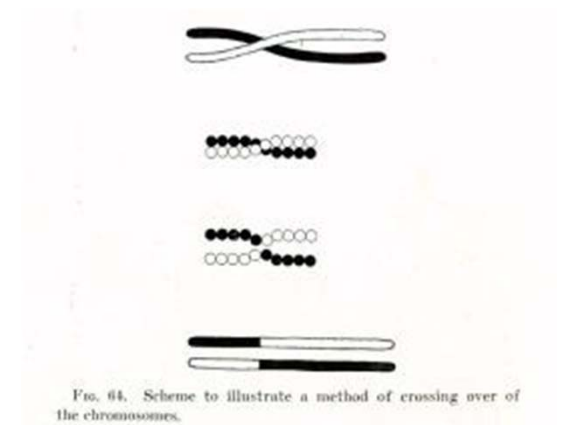
Recombination!

- Shuffling of alleles



Two means of recombination

- Independent assortment
 - Process with different chromosomes
- Crossing over
 - Sometimes the word “recombination” is used specifically referring to crossing over
 - *Wikipedia* focuses just on this



Recap: Independent Assortment

- Last time, we assumed that the traits studied were inherited independently
 - Could multiply probabilities

T t S s x T t S s

$\frac{1}{4}$ TT, $\frac{1}{2}$ Tt, $\frac{1}{4}$ tt

$\frac{1}{4}$ SS, $\frac{1}{2}$ Ss, $\frac{1}{4}$ ss

9 possible genotypes:

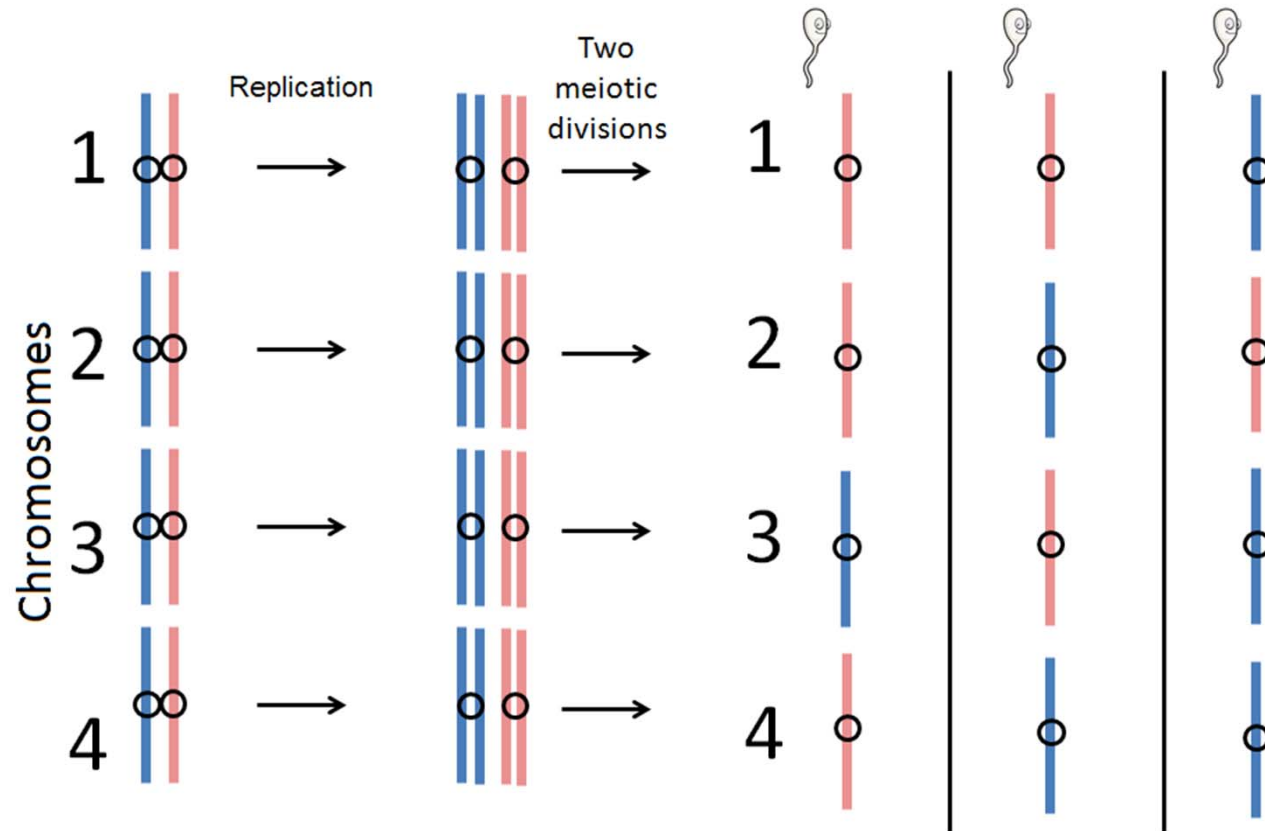
1 TTSS 2 TTSSs 1 TTss

2 TtSS 4 TtSs 2 Ttss

1 ttSS 2 ttSs 1 ttss

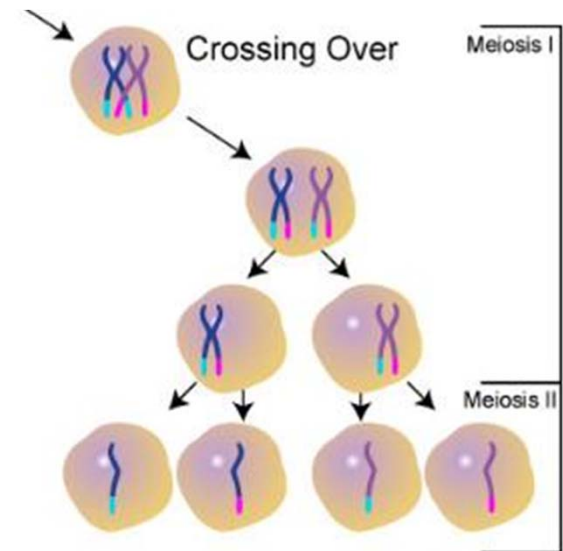
Each / 16

Meiosis



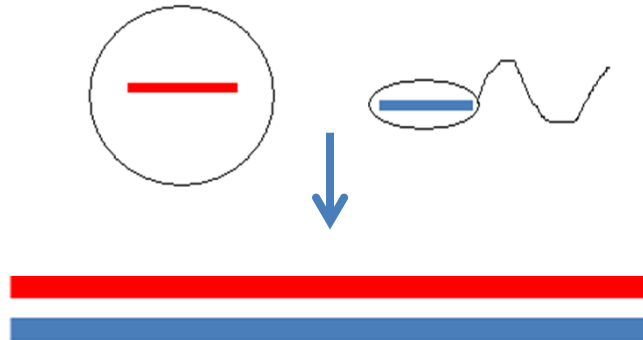
... but it isn't so simple...

- Often, homologous chromosomes trade pieces with each other during meiosis
 - Happens when doubled
 - Called “crossing over”
 - Can form mixed (“recombinant”) chromosomes in gametes



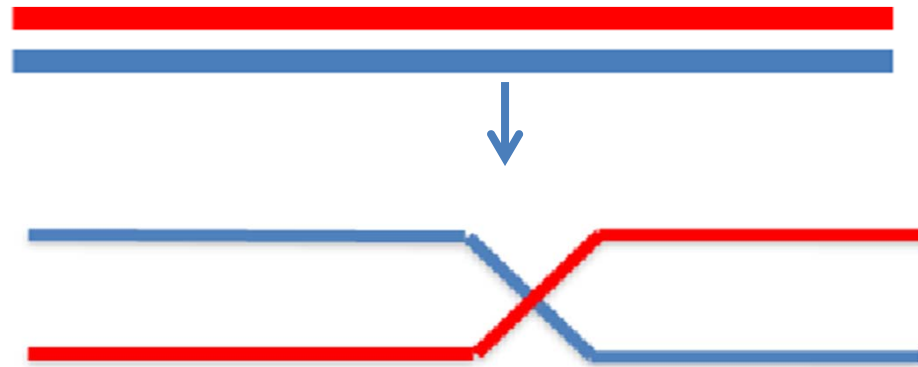
What are we working with?

- Two homologous chromosomes, one inherited from the egg and one from the sperm



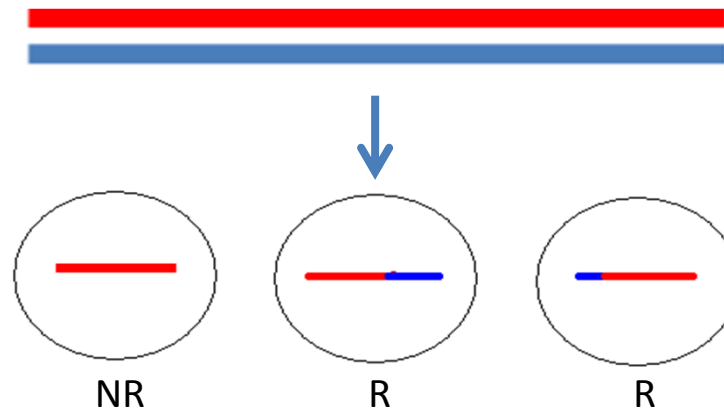
What are we working with?

- This heterozygote sometimes experiences crossing over during meiosis



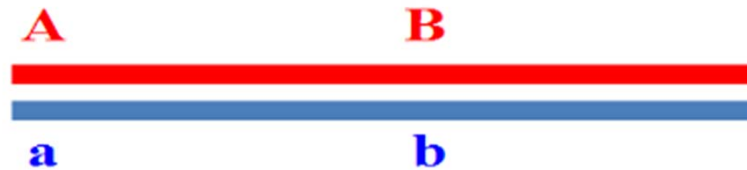
What are we working with?

- This heterozygote then passes on a noncrossover (nonrecombinant) or crossover (recombinant) chromosome to its eggs



How do we tell?

- We use look at alleles at genetic markers (discussed soon) along the chromosome!

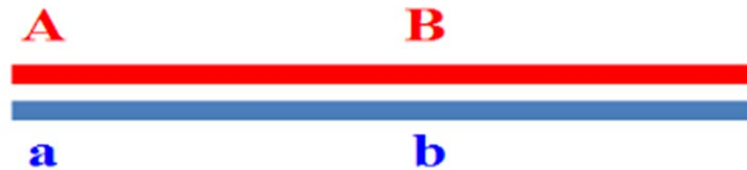


Nonrecombinant eggs: **A B** , **a b**

Recombinant eggs: **a B** , **A b**

How do we tell?

- We use look at alleles at genetic markers (discussed soon) along the chromosome!



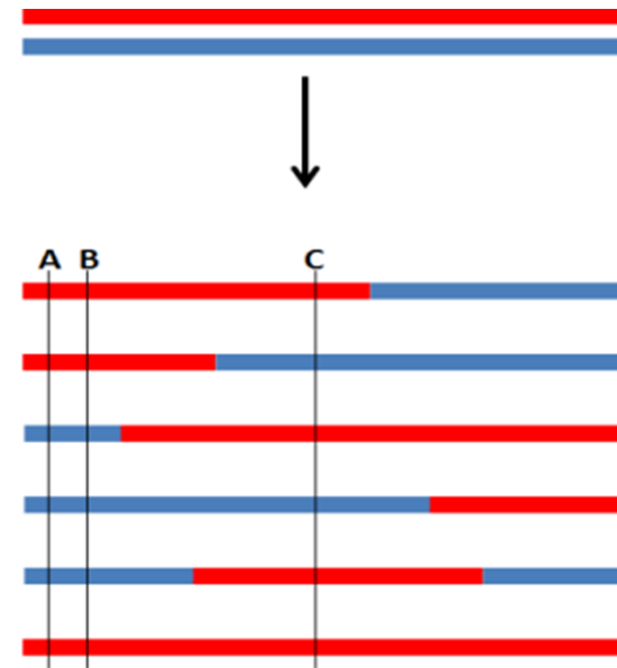
Nonrecombinant eggs: **A B** , **a b**

Recombinant eggs: **a B** , **A b**

- If totally linked (no recombination), only get Nonrecombinant eggs

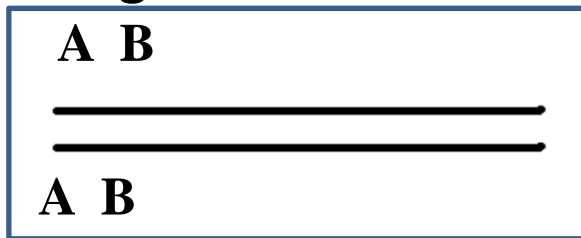
Neighboring gene variants (alleles) tend to stay associated

- Start with heterozygote
- Produces gametes, with crossover(s) occurring along the length
 - How often are A and B “linked” (ie, same color)?
 - How often are A and C “linked”?
 - What does this mean?



How to follow:

- If we assume total linkage
- Imagine dad is AABB



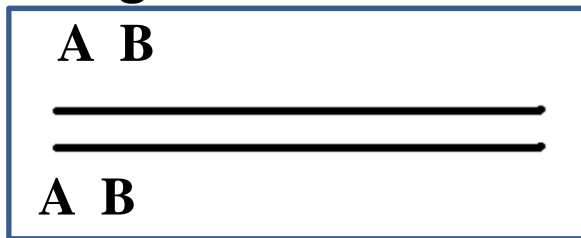
- Imagine mom is AaBb:



	AB	AB
Ab		
aB		

How to follow:

- If we assume total linkage
- Imagine dad is AABB



- Imagine mom is AaBb:

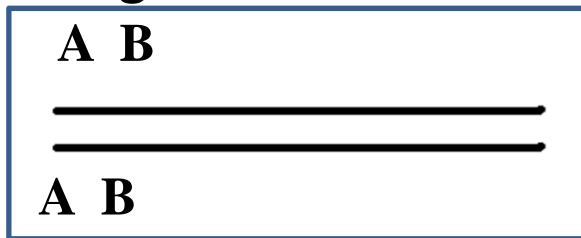


Punnett square showing the cross between the dad (AABB) and the mom (AaBb). The dad's gametes (AB) are in the top row, and the mom's gametes (Ab and aB) are in the left column. The resulting offspring genotypes are shown in the cells.

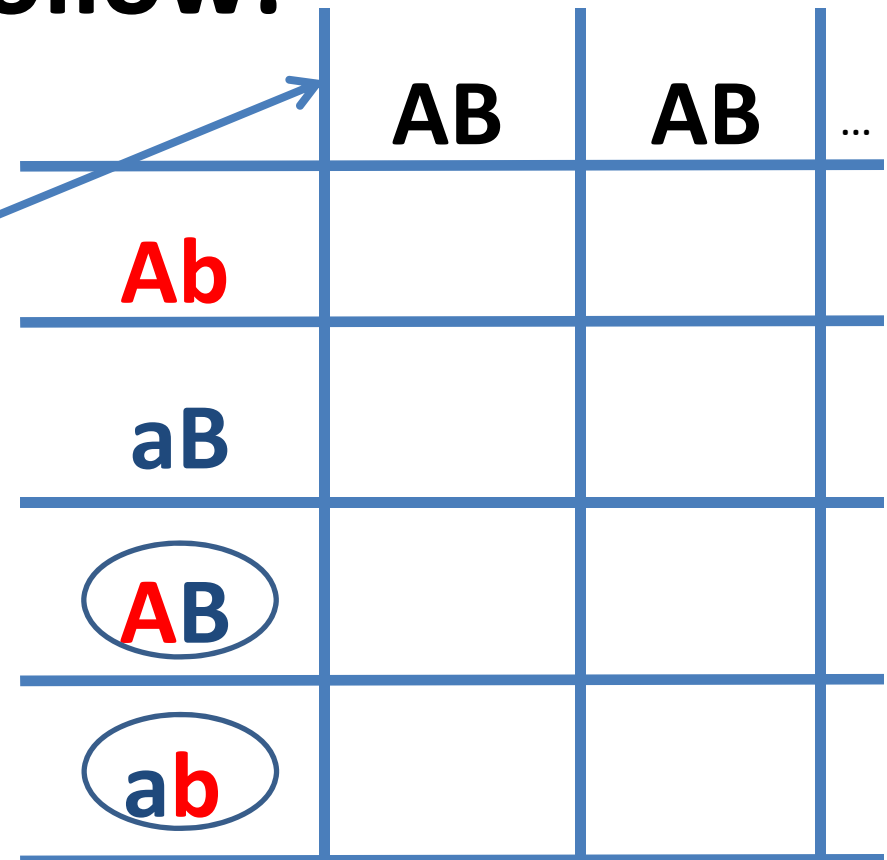
	AB	AB
Ab	AABb	AABb
aB	AaBB	AaBB

How to follow:

- If we assume no linkage
- Imagine dad is AABB

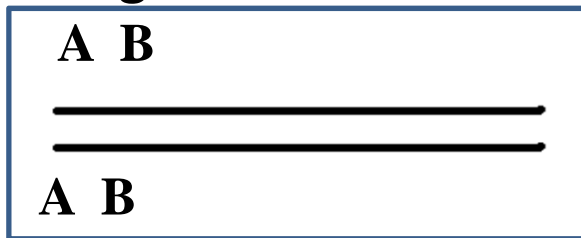


- Imagine mom is AaBb:



How to follow:

- If we assume no linkage
- Imagine dad is AABB



- Imagine mom is AaBb:



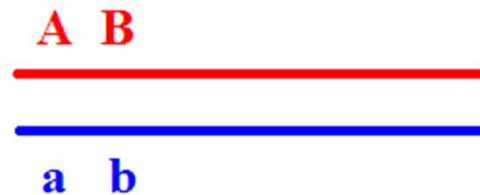
	AB	AB	...
Ab	A ABb	A ABb	
aB	AaBB	AaBB	
AB	A ABB	A ABB	
ab	AaB b	AaB b	

“Phase” matters...

Red chromosome came from this individual's dad
Blue chromosome came from this individual's mom

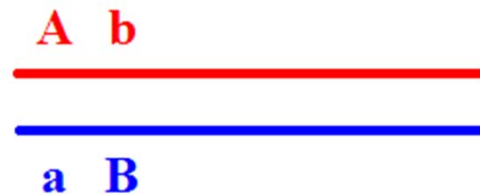
Recombinant gametes

•AaBb



Ab aB

•AaBb



AB ab

Punchline: Knowing an individual is “AaBb” is not enough to understand which gametes are recombinant vs. parental

Image Credits, Unit 4-1

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