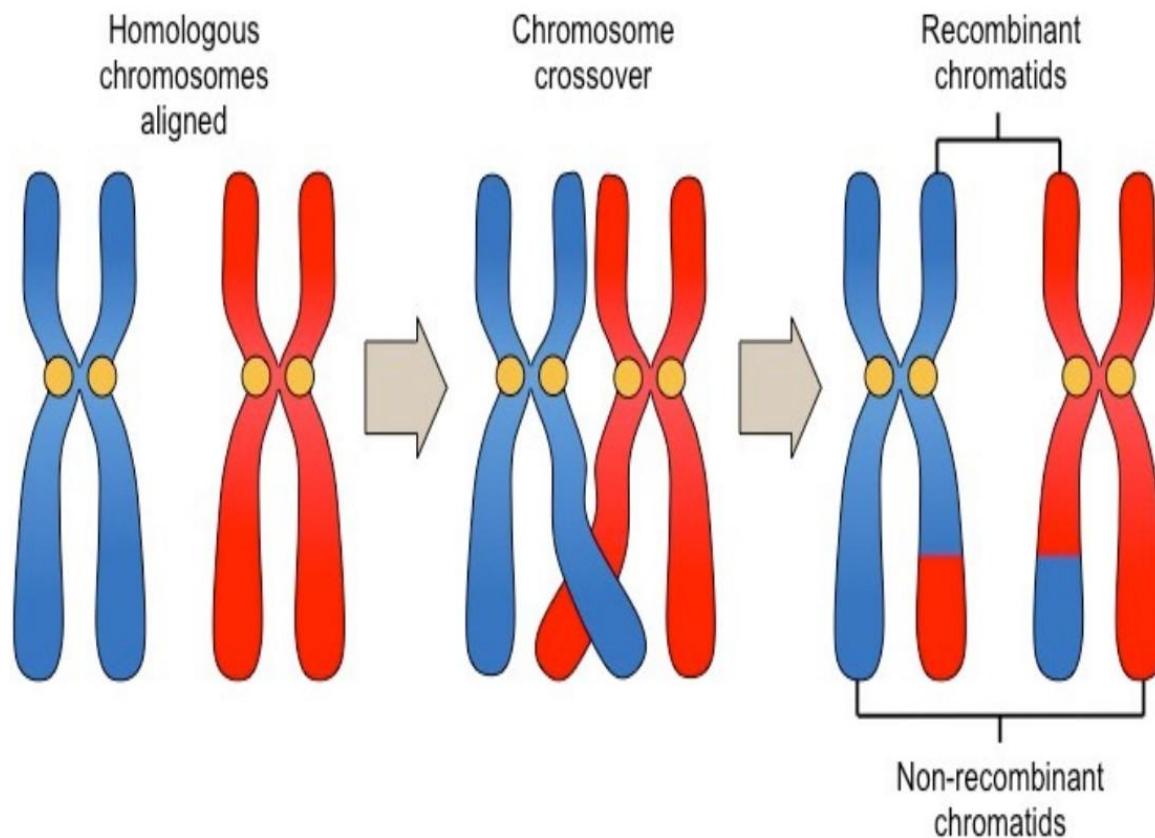


Marvel: “Infinity War is the most ambitious crossover event in history”

Me:



Recombination, linkage, and the 3-point testcross

pure breeding
homozygous for trait of
interest

Both pure breeding



"Aa" + "aa"

Aa	
A	a
A	(AA)
a	aa

"aa"

aa	
a	a
a	(aa)
a	aa

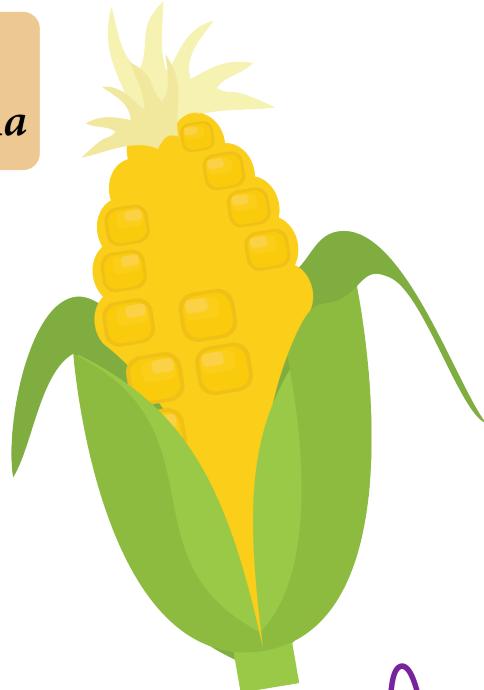
(0%)

heterozygote

all
tuft!

(dominant)

Tuft
 AA or Aa



(recessive)

No tuft
 aa



"fester" = homozygous
recessive

	A	a
a	ta	aa
a	Aa	aa

1:1 phenotypic ratio

Tuft
 AA or Aa



No tuft
 aa

"monohybrid" cross

	A	a
A	AA	Aa
a	Aa	aa

3:1 phenotypic ratio

Recombination: more ways to shuffle

Purple corn,
Orange stem

$$\begin{array}{c} yl \quad gr \\ \hline yl \quad gr \end{array}$$

"fester"

$$yl \quad gr$$

Possible pollen (sperm) genotypes



\times



Yellow corn,
Green stem

$$\begin{array}{c} Yl+ \quad Gr+ \\ \hline yl \quad gr \end{array}$$

Possible ovule (egg) genotypes

$$Yl^+ \quad Gr^+$$

$$yl \quad gr$$

$$Yl^+ \quad gr$$

$$yl \quad Gr^+$$

Purple corn,
Orange stem

$$\begin{array}{c} yl \quad gr \\ \hline yl \quad gr \end{array}$$



\times



Possible pollen (sperm) genotypes

Parental genotypes

yl gr

yl gr

Yellow corn,
Green stem

$$\begin{array}{c} Yl+ \quad Gr+ \\ \hline yl \quad gr \end{array}$$

Possible ovule (egg) genotypes

Yl+ Gr+

Yl+ gr

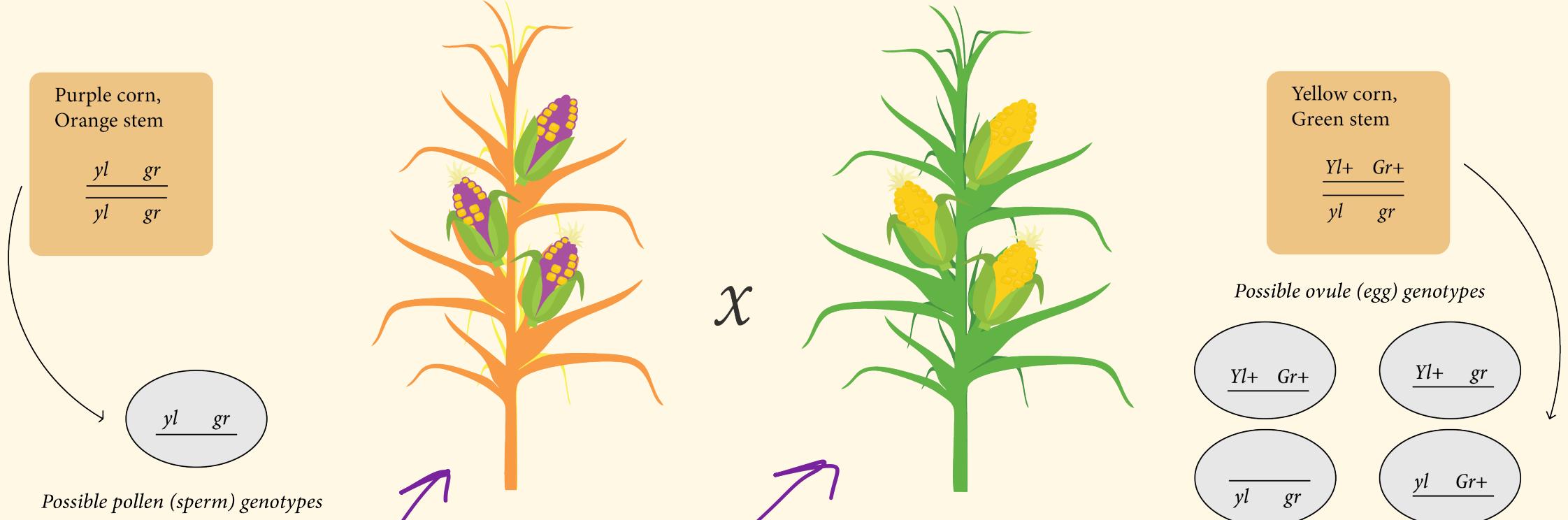
yl gr

yl Gr+

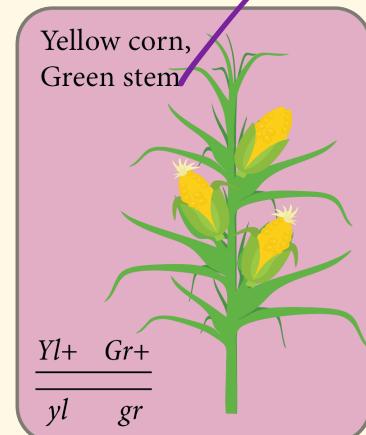
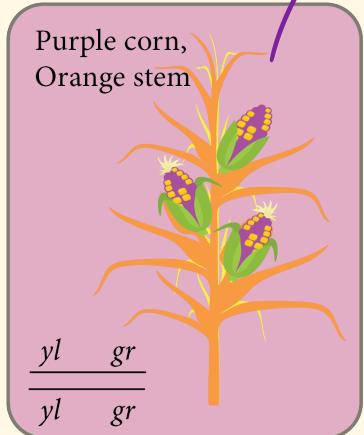
Recombinant genotypes

yl gr

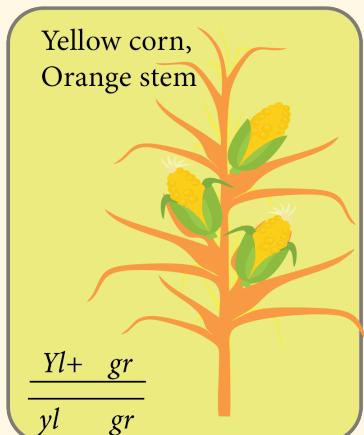
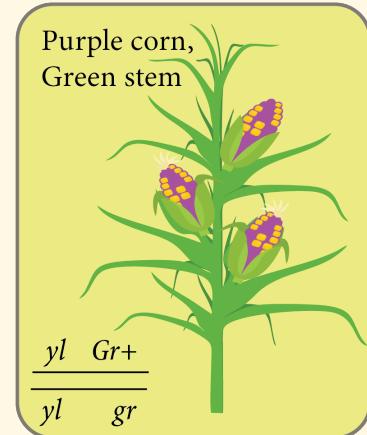
yl gr



Parental genotypes



Recombinant genotypes



switched
up!

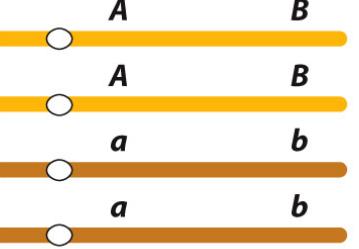
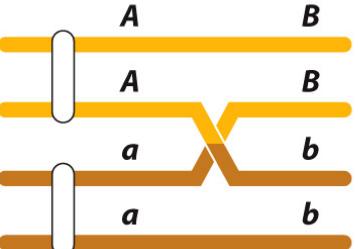
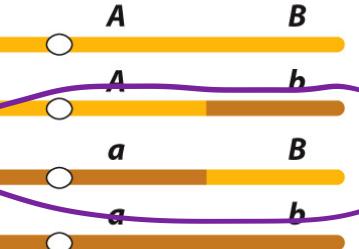
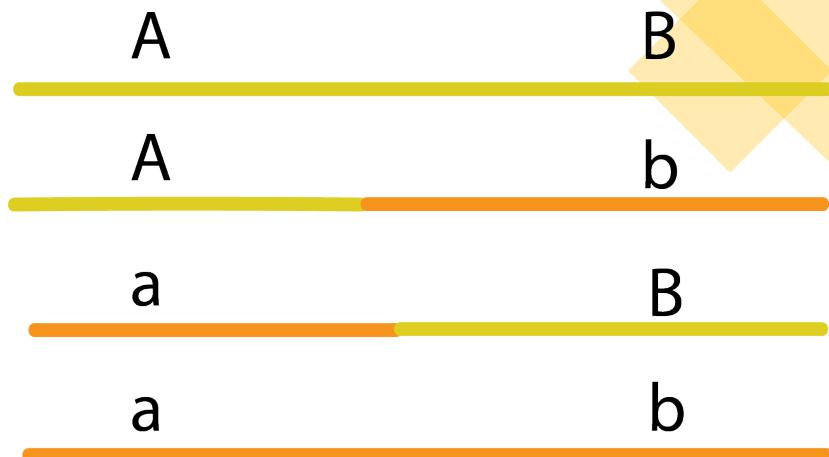
	Meiotic chromosomes	Meiotic products	
Meioses with no crossover between the genes			Parental Parental Parental Parental
Meioses with a crossover between the genes			Parental Recombinant Recombinant Parental

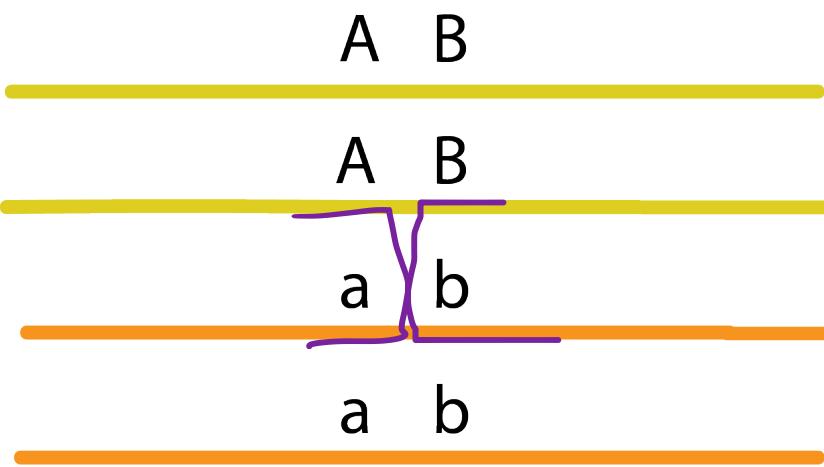
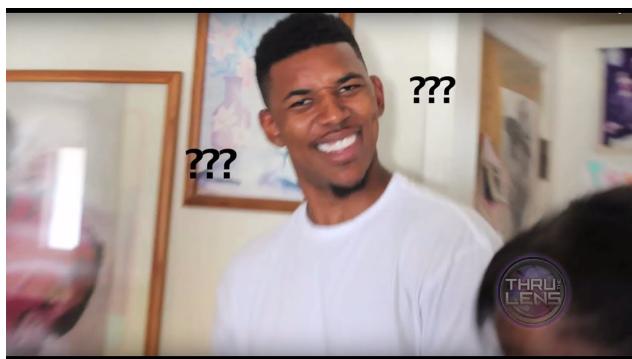
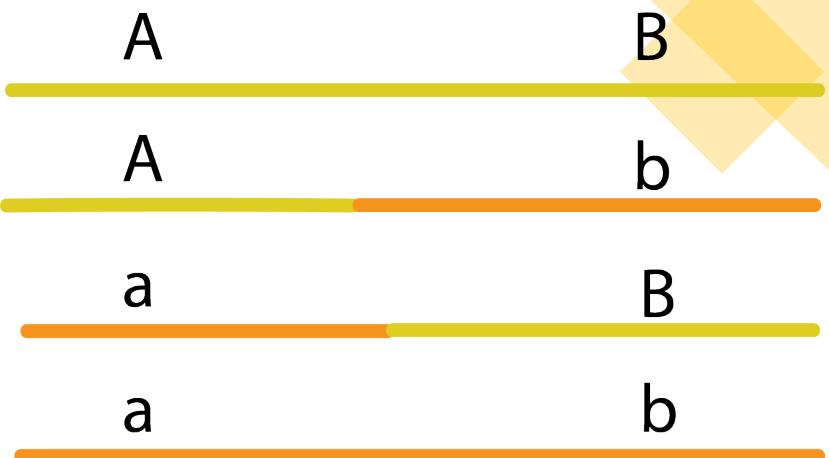
Figure 4-7

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→ at most 50%
 they two can exchange genes



What is happening
in physical space ??



linked = close together

crossing over between linked genes less likely!

Purple corn,
Orange stem

$$\begin{array}{c} yl \quad gr \\ \hline yl \quad gr \end{array}$$

$$\begin{array}{c} yl \quad gr \\ \hline yl \quad gr \end{array}$$

Possible pollen (sperm) genotypes



\times



Yellow corn,
Green stem

$$\begin{array}{c} Yl+ \quad Gr+ \\ \hline yl \quad gr \end{array}$$

Possible ovule (egg) genotypes

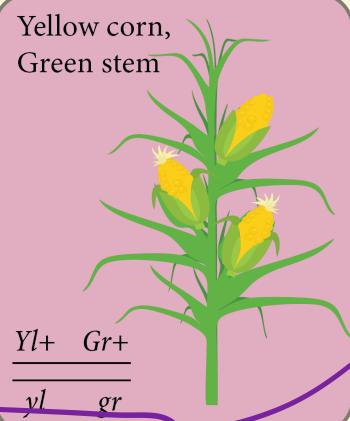
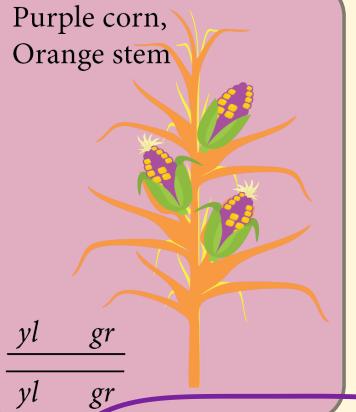
$$\begin{array}{c} Yl+ \quad Gr+ \\ \hline yl \quad gr \end{array}$$

$$\begin{array}{c} Yl+ \quad gr \\ \hline yl \quad gr \end{array}$$

$$\begin{array}{c} yl \quad gr \\ \hline yl \quad gr \end{array}$$

$$\begin{array}{c} yl \quad Gr+ \\ \hline yl \quad gr \end{array}$$

Parental genotypes



Total offspring =

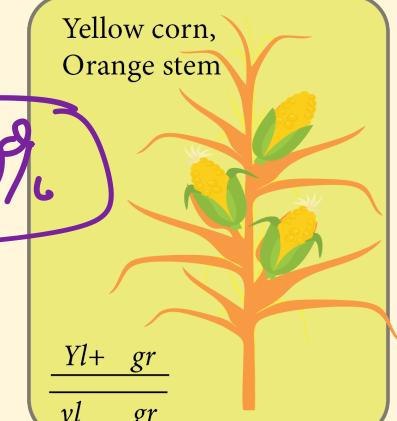
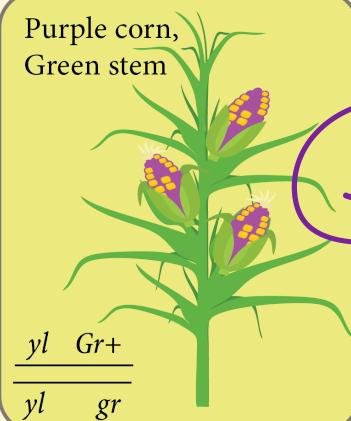
700

$240 + 254$

=

700
70% parental

Recombinant genotypes



100

106

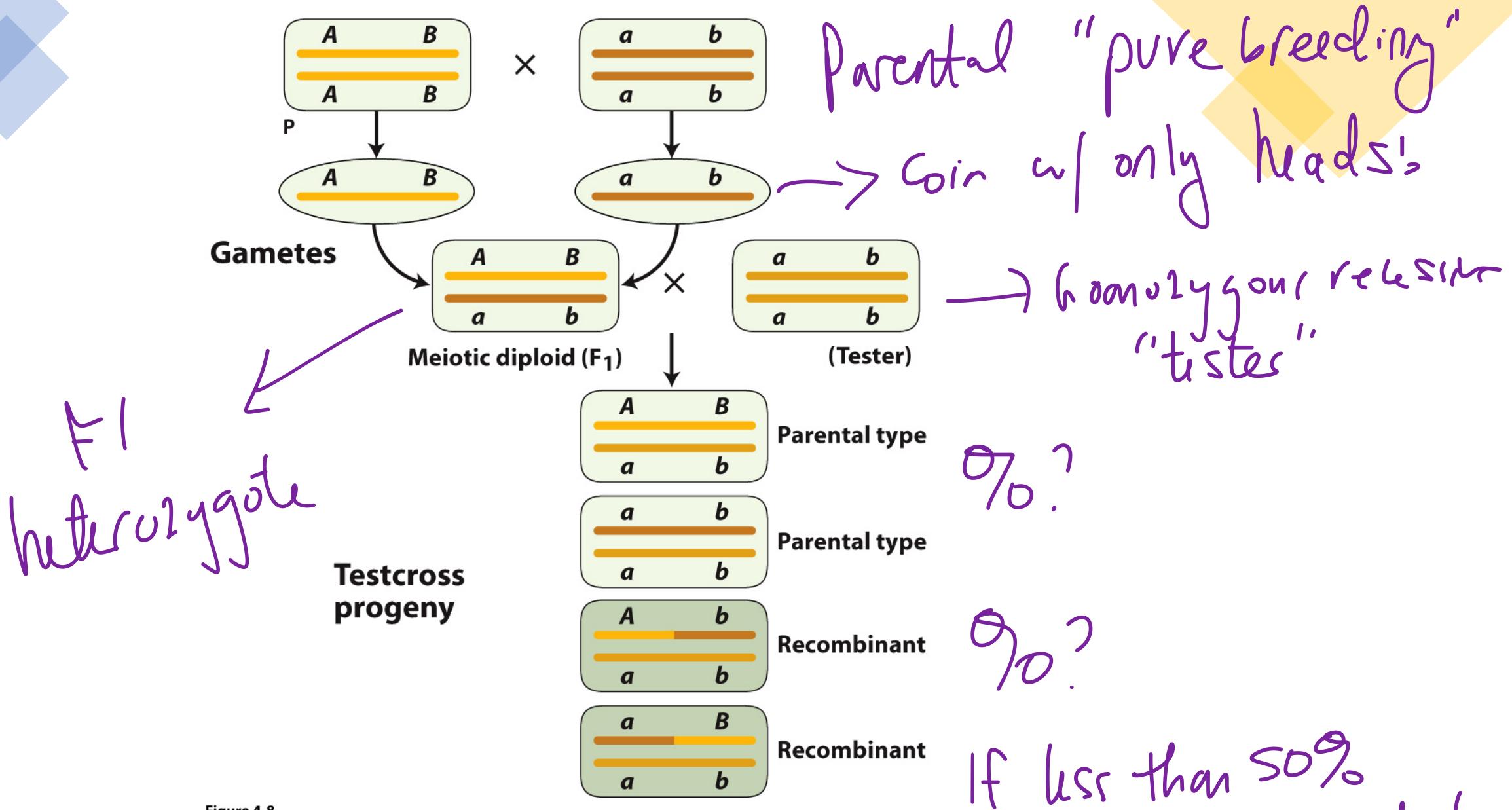
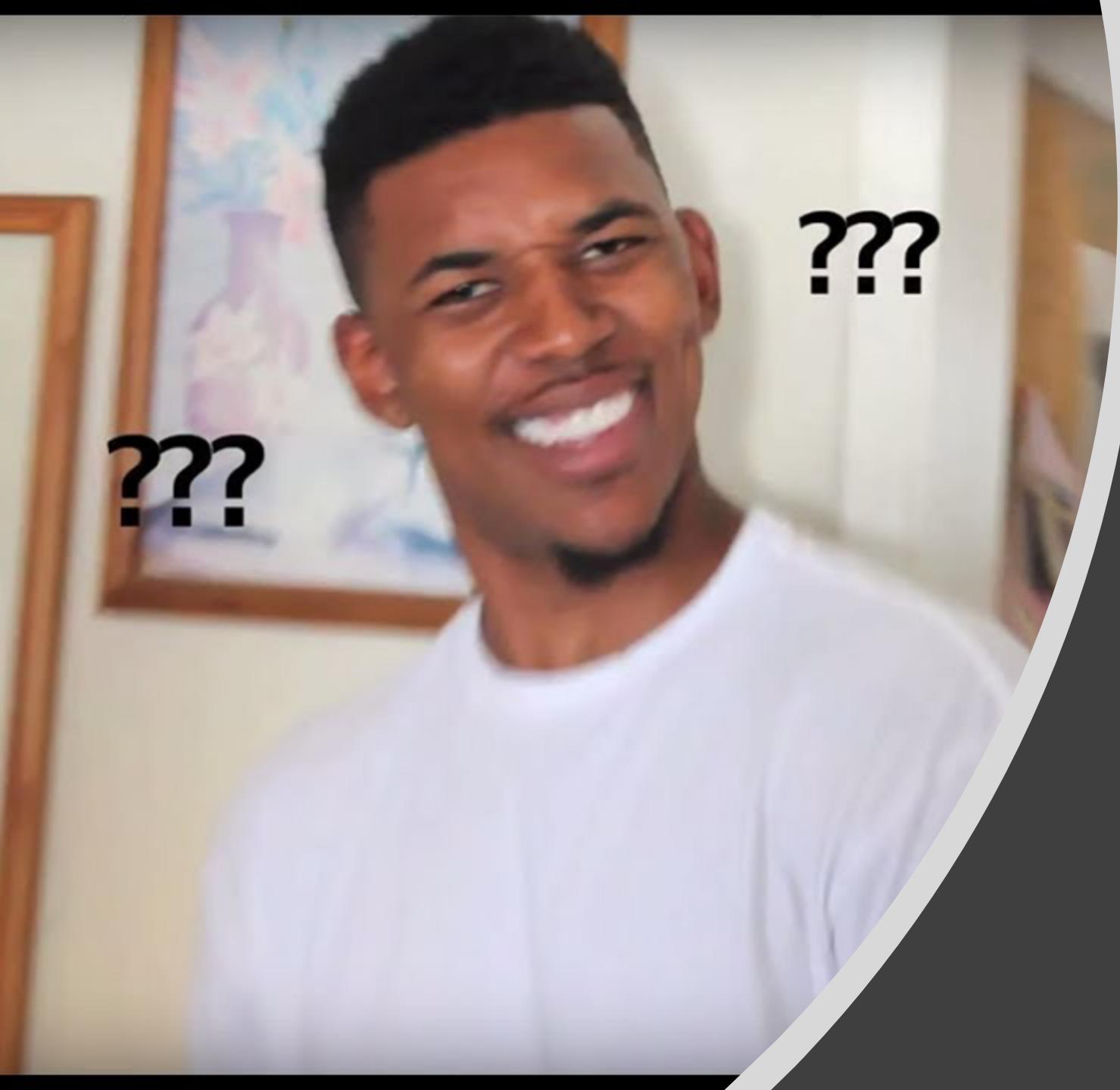


Figure 4-8

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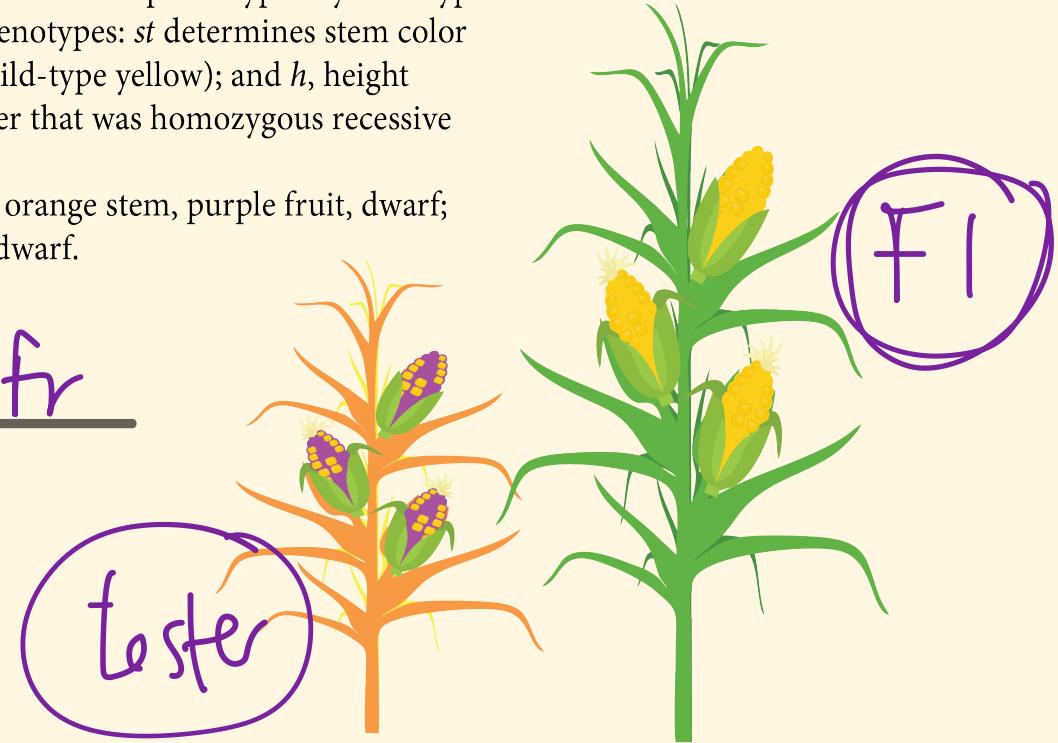


Three linked
genes?

R. A. Emerson crossed two different pure-breeding lines of corn and obtained a phenotypically wild-type F1 that was heterozygous for three alleles that determine recessive phenotypes: *st* determines stem color (recessive orange, wild-type green); *fr*, fruit color (recessive purple, wild-type yellow); and *h*, height (recessive dwarf, wild-type normal). He testcrossed the F1 with a tester that was homozygous recessive for the three genes and obtained these progeny phenotypes:

355 orange stem; 339 purple fruit, dwarf; 88 completely wild-type; 55 orange stem, purple fruit, dwarf; 21 dwarf; 17 orange stem, purple fruit; 2 purple fruit; 2 orange stem, dwarf.

Number	Gametes	<i>st - h</i>	<i>h - fr</i>
355	<i>St h⁺ Fr⁻</i>	<i>R</i>	<i>R +</i>
339	<i>St⁺ h Fr</i>	<i>R</i>	<i>R +</i>
88	<i>St⁻ h⁺ fr⁺</i>	<i>R</i>	<i>R +</i>
55	<i>st h fr</i>	<i>R</i>	<i>R +</i>
21	<i>St^f h fr⁻</i>	<i>R</i>	<i>R +</i>
17	<i>st h⁺ fr</i>	<i>R</i>	<i>R +</i>
2	<i>St⁺ h⁺ fr</i>	<i>R</i>	<i>R</i>
2	<i>st h Fr⁻</i>	<i>R</i>	<i>R</i>
879		$147/879 \times 100\%$ $= 16.7\text{ mu}$	$42/879 \times 100\%$ $= 4.7\text{ mu}$



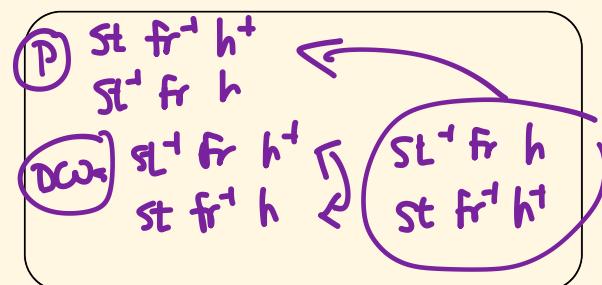
Parental genotypes:

st h fr /
st⁻ h fr

st h⁺ fr⁺ /
st⁺ h fr

Determine gene order:

h in the middle!



The Steps

1. Find the phenotypes that have the highest number of offspring: these are your parental classes!
2. Find the phenotypes with the fewest number of offspring: these are your double crossovers!
3. Determine gene order by comparing these two classes
4. Re-write all genotypes in descending order with proper gene orientation
5. Make your columns and evaluate genes pairwise
6. Count totals from each class (parental, SCO, DCO)
7. Divide by TOTAL number of progeny for % recombinants
8. Remember: % recombinants == map units!