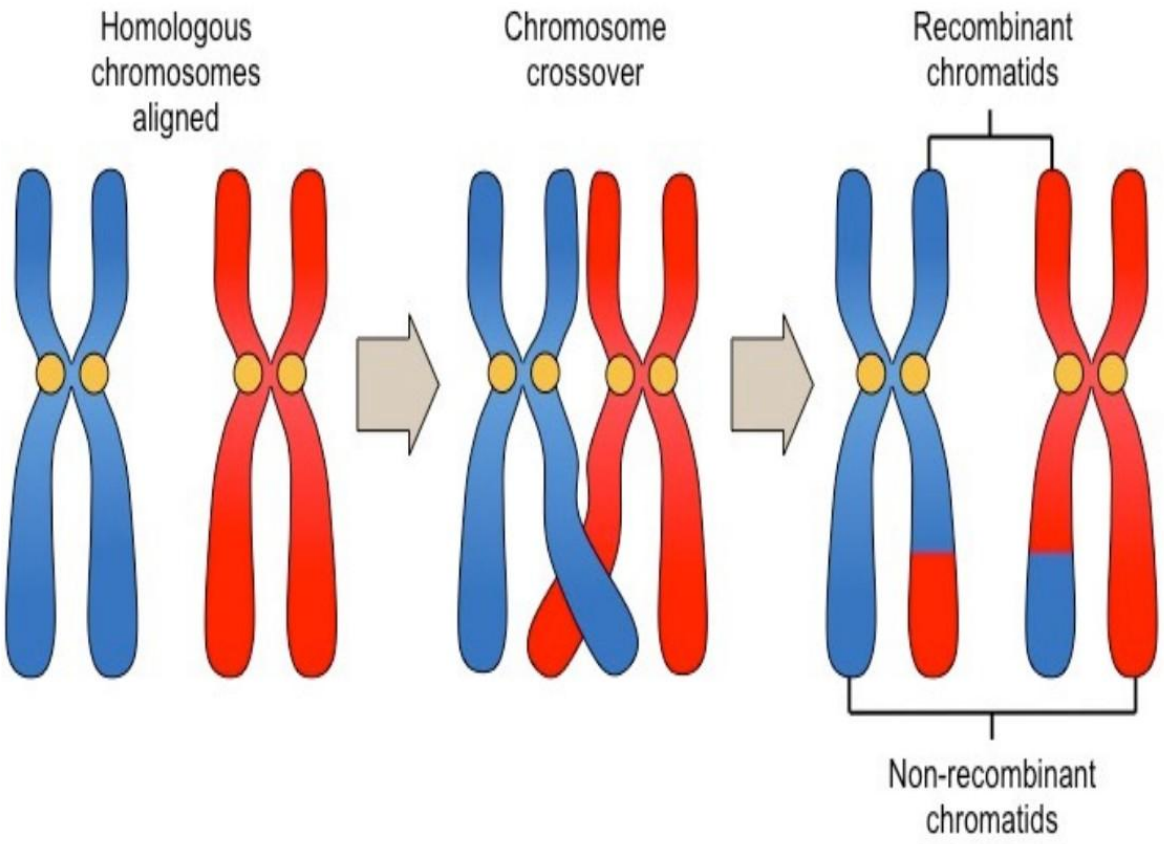
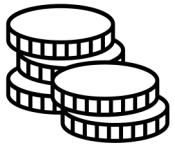
Marvel: “Infinity War is the most ambitious crossover event in history”
Me:



Recombination, linkage, and the 3-point testcross



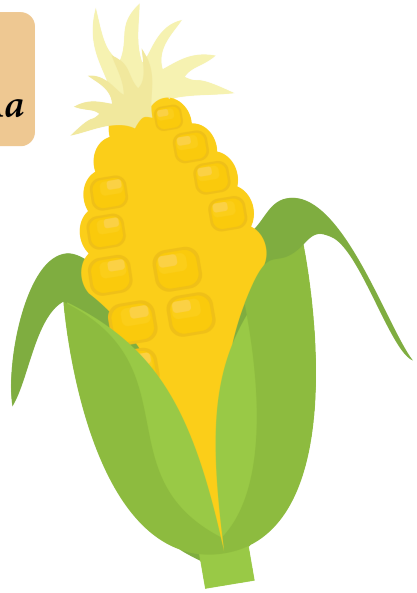
Independent assortment:
It's all coin flips!

A locus

Tuft
AA or Aa

No tuft
aa

A a



a

	a	a
A		
a		

Recombination: more ways to shuffle

Purple corn,
Orange stem

$$\frac{yl \quad gr}{yl \quad gr}$$

"tester"

yl gr

Possible pollen (sperm) genotypes

x

Yellow corn,
Green stem

$$\frac{Yl+ \quad Gr+}{yl \quad gr}$$

Possible ovule (egg) genotypes

yl+ Gr+

yl+ gr

yl gr

yl Gr+

Purple corn,
Orange stem

$\frac{yl \quad gr}{yl \quad gr}$

x

Yellow corn,
Green stem

$\frac{Yl+ \quad Gr+}{yl \quad gr}$

Possible ovule (egg) genotypes

$\frac{Yl+ \quad Gr+}{}$ $\frac{Yl+ \quad gr}{}$ $\frac{}{yl \quad gr}$ $\frac{yl \quad Gr+}{}$

$\frac{yl \quad gr}{}$

Possible pollen (sperm) genotypes

Parental genotypes

Recombinant genotypes

yl gr yl gr yl gr yl gr

Purple corn,
Orange stem

$\frac{yl \quad gr}{yl \quad gr}$

x

Yellow corn,
Green stem

$\frac{Yl+ \quad Gr+}{yl \quad gr}$

$\frac{yl \quad gr}{}$

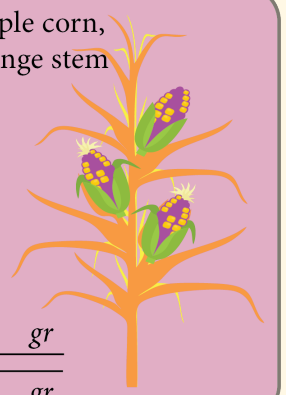
Possible pollen (sperm) genotypes

Possible ovule (egg) genotypes

$\frac{Yl+ \quad Gr+}{}$ $\frac{Yl+ \quad gr}{}$ $\frac{}{yl \quad gr}$ $\frac{yl \quad Gr+}{}$

Parental genotypes

Purple corn,
Orange stem



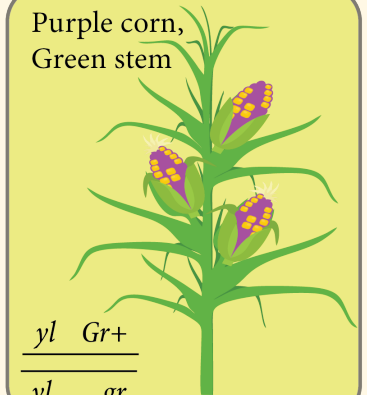
$\frac{yl \quad gr}{yl \quad gr}$

Yellow corn,
Green stem

$\frac{Yl+ \quad Gr+}{yl \quad gr}$

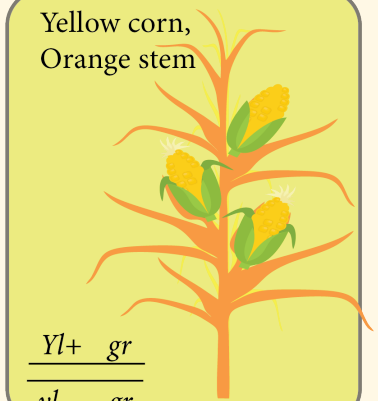
Recombinant genotypes

Purple corn,
Green stem



$\frac{yl \quad Gr+}{yl \quad gr}$

Yellow corn,
Orange stem



$\frac{Yl+ \quad gr}{yl \quad gr}$

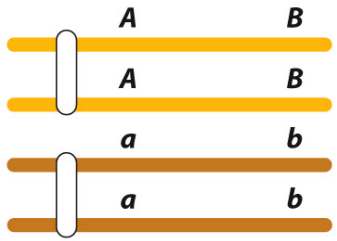
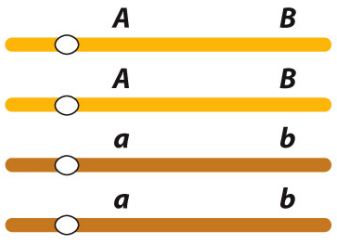
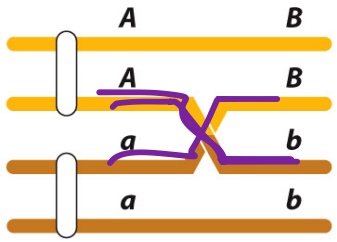
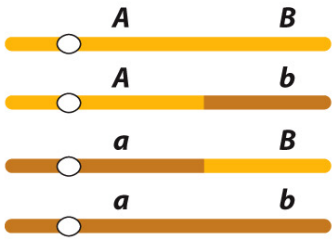
	Meiotic chromosomes	Meiotic products	
Meioses with no crossover between the genes			Parental Parental Parental Parental
Meioses with a crossover between the genes			Parental Recombinant Recombinant Parental

Figure 4-7
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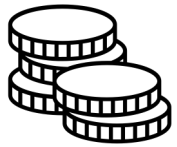
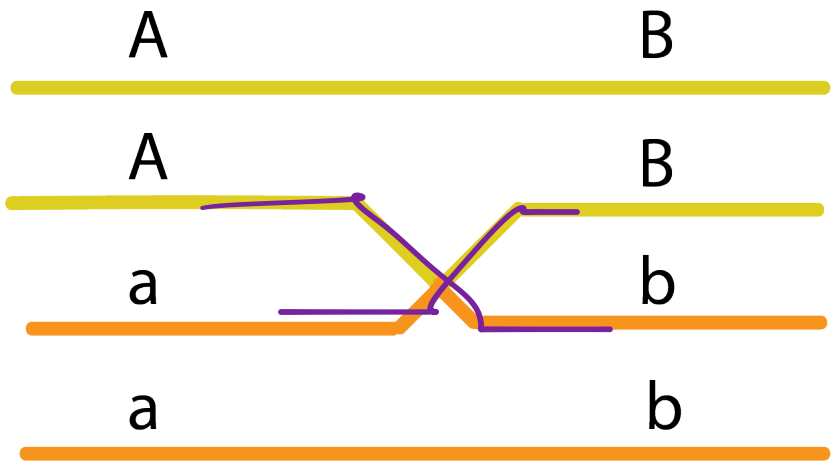
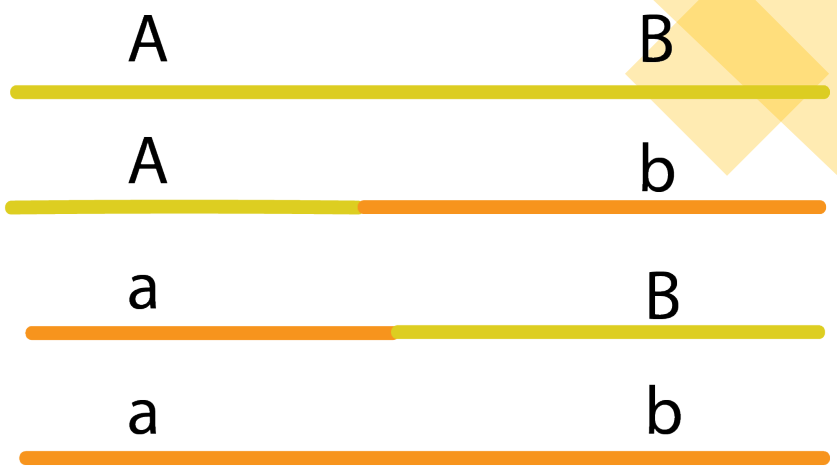
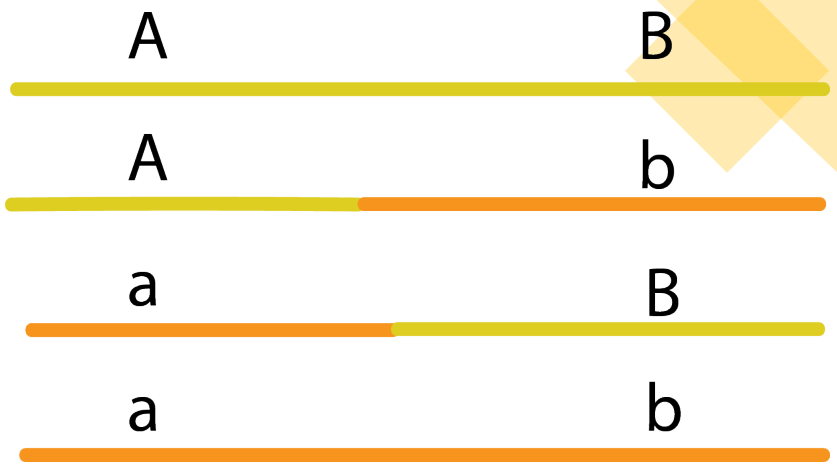
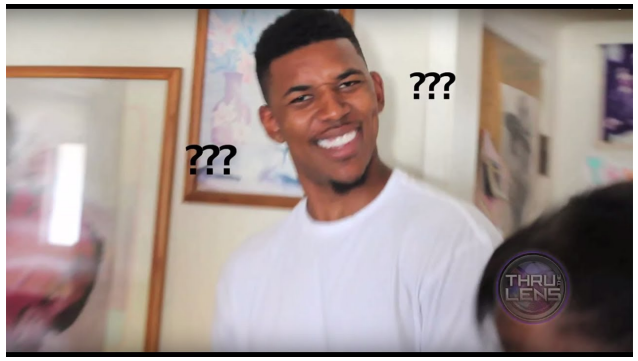


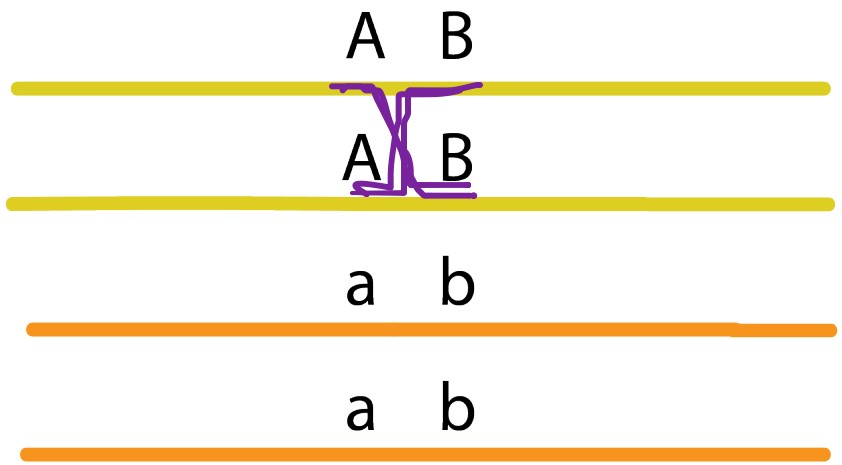
It's all coin flips!
Well, except…….


A
B
A
B
a
b
a
b


A
B
A
b
a
B
a
b







→ linked = fewer than 50% recombinants

Purple corn,
Orange stem

$\frac{yl \quad gr}{yl \quad gr}$

x

Yellow corn,
Green stem

$\frac{Yl+ \quad Gr+}{yl \quad gr}$

$yl \quad gr$

Possible pollen (sperm) genotypes

Possible ovule (egg) genotypes

$Yl+ \quad Gr+$

$Yl+ \quad gr$

$yl \quad gr$

$yl \quad Gr+$

OH NO!!!
My original arithmetic was wrong — see how I fixed it below!

240+254 = 494

494/600 = 82%

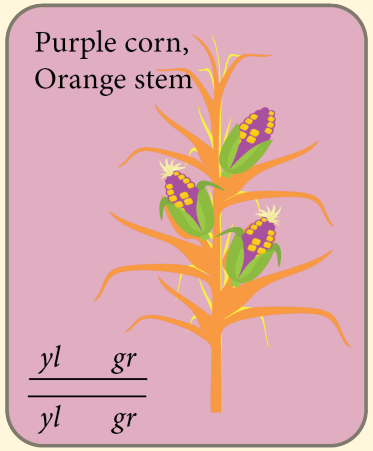
50+56 = 106

106/600 = 18%

gr 18 mu yl

Parental genotypes

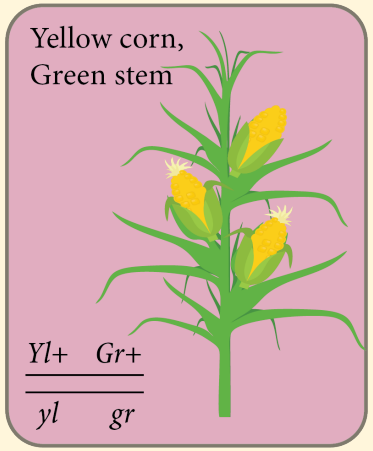
Purple corn,
Orange stem



$\frac{yl \quad gr}{yl \quad gr}$

240

Yellow corn,
Green stem

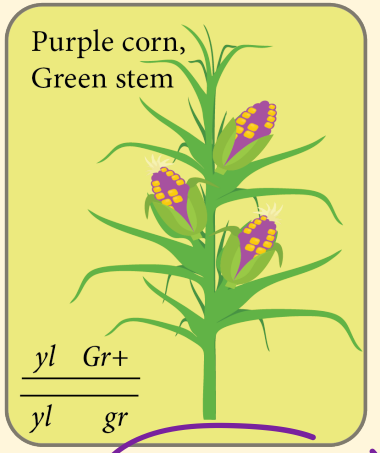


$\frac{Yl+ \quad Gr+}{yl \quad gr}$

254

Recombinant genotypes

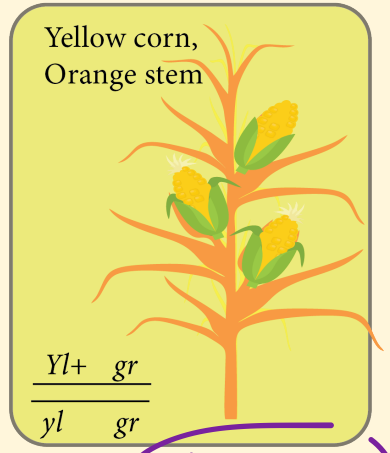
Purple corn,
Green stem



$\frac{yl \quad Gr+}{yl \quad gr}$

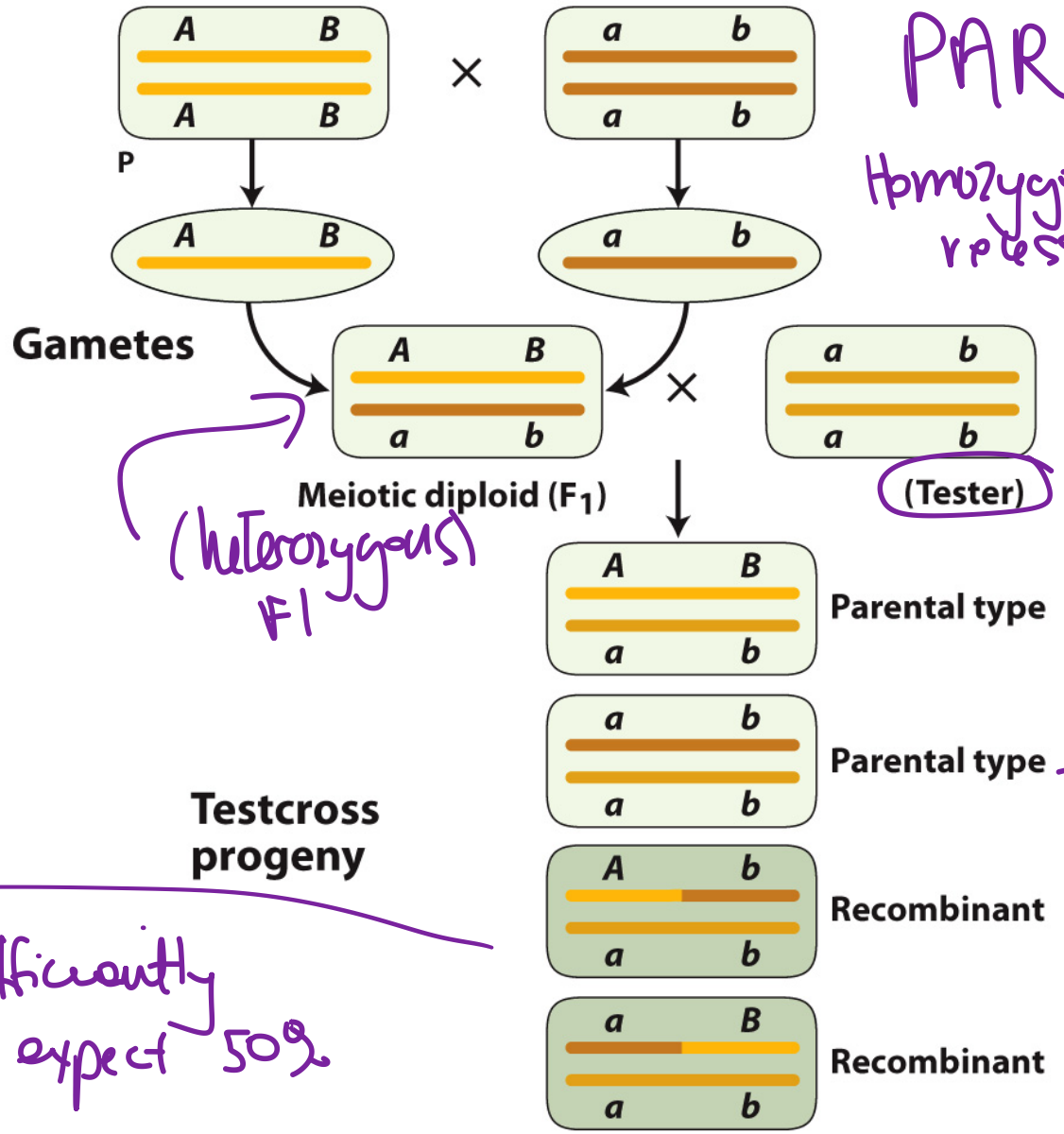
100 50

Yellow corn,
Orange stem



$\frac{Yl+ \quad gr}{yl \quad gr}$

106 56



PARENTALS (all homozygous)

Homozygous recessive + homozygous dominant = heterozygous ALL

	A	A
a	Aa	Aa
a	Aa	Aa

(heterozygous F1)

will equal each other

+ ~100%

will equal each other

If genes are sufficiently far apart, you expect 50% recombinants

Figure 4-8
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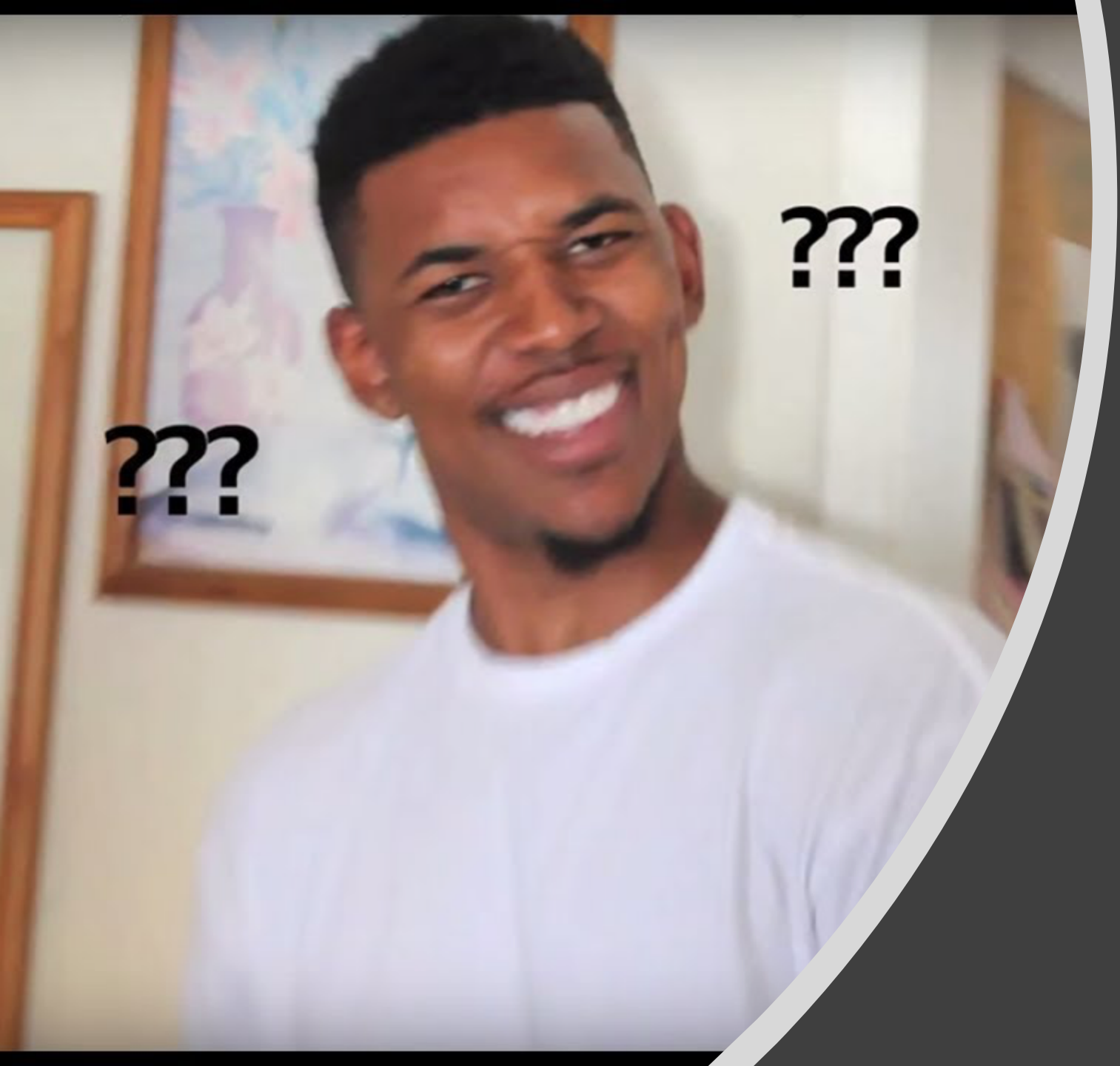
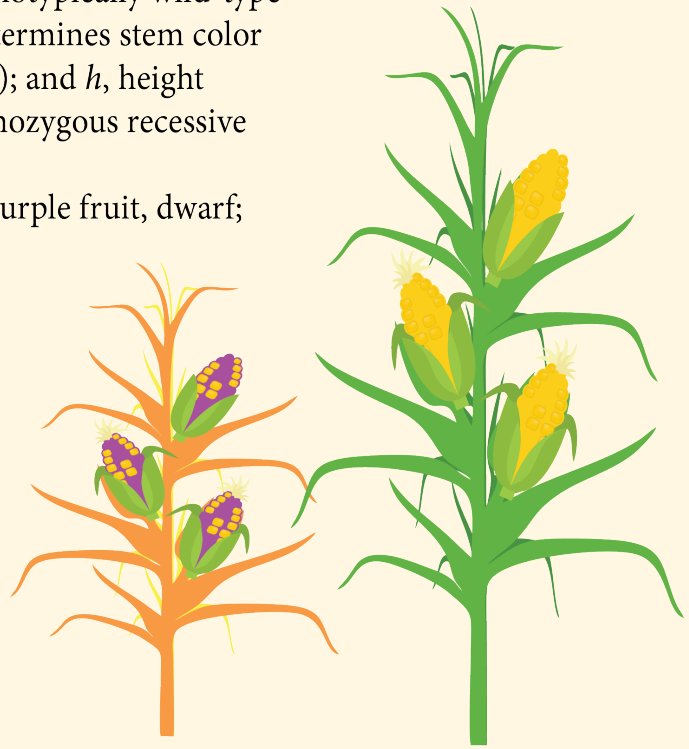


Three linked genes?

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	st - h	h - fr
parental	355	st + +		
	339	+ h fr		
SCO	88	+ + +	R	
	55	st h fr	R	
SCO	21	+ h +		R
	17	st + fr		R
DCO	2	+ + fr	R	R
	2	st h +	R	R
	879		147/879 = 0.167 = 16.7%	42/879 = 0.05 = 5%

Parental genotypes:

st h fr / st h fr

st + + / + h fr

Determine gene order:

st + + / + Fr h → middle!

The Steps

1. Find the phenotypes that have the highest number of offspring → parental!
2. Determine gene order → compare DCOs
3. Re-write in descending order with proper gene orientation → make life easier!
4. Make your columns and evaluate genes pairwise → compare (P)
5. Count totals from each class (parental, SCO, DCO)
6. Divide by TOTAL number of progeny for % recombinants
7. Remember: % recombinants == map units!