CONCEPT: TRI-HYBRID CROSS FOR MAPPING

● A tri-hybrid cross, is a mating to look at the inheritance of _____ traits in the offspring

□ For unlinked genes, this should follow normal Mendelian inheritance

□ For linked genes, recombination frequencies in the offspring can be used to map all three gene loci

EXAMPLE:

In a cross of fruit flies, there are three traits of interest.

1. Eye color: v+ = red, v = vermillion (like orange/purpleish),
2. Wing veins: cv+= presence of wing crossvein, cv = absence of crossvein
3. Wing shape: ct+ = normal wing, ct = cut wing edges

P: v+/v+ · cv/cv · ct/ct x v/v · cv+/cv+ · ct+/ct+

Parental phenotypes: Red, crovsveinless,cut wings x vermillion, crossvein, normal wing

Gametes: v+ · cv · ct v · cv+ · ct+

F_1 trihybrid v+/v · cv/cv+ · ct/ct+

F_1 test cross v+/v · cv/cv+ · ct/ct+ x v/v · cv/cv · ct/ct

F_1 phenotypes: Red, crossvein, normal wing vermillion, crossvienless, cut wings

Parental gametes: $\frac{v+ \quad cv \quad ct}{v \quad cv+ \quad ct+}$

Gametes	**Phenotypes**	**Offspring #**	Recomb. v and cv	Recomb v and ct	Recomb cv and ct
v · cv⁺ · ct+	Parental	580			
v+ · cv · ct	Parental	592			
v · cv · ct+	Recombinant	45			
v+ · cv+ · ct	Recombinant	40			
v · cv · ct	Recombinant	89			
v+ · cv+ · ct+	Recombinant	94			
v · cv+ · ct	Recombinant	3			
v+ · cv · ct+	Recombinant	5			
	Total	1448	268	191	93

Now, you determine the recombination frequencies:

1. For v and cv: RF = 268/1448 = 18.5
2. For v and ct: RF = 191/1448 = 13.2
3. For cv and ct: RF = 93/1448 = 6.4

What can we determine from these _____ frequencies?

1. All three genes are linked, because their RFs are less than 50%
2. The orientation and distances of the gene loci

□ Why does 13.2 + 6.4 = 19.6 and not the 18.5 (RF for v and cv)?

- We should have counted the double cross overs twice, instead of once!

$$\frac{v+ \quad ct \quad cv}{v \quad ct+ \quad cv+}$$

Gametes	**Phenotypes**	**Offspring #**	Recomb. v and cv
v · ct+ · cv+	Parental	580	
v+ · ct · cv	Parental	592	
v · ct+ · cv	Recombinant	45	R
v+ · ct · cv+	Recombinant	40	R
v · ct · cv	Recombinant	89	R
v+ · ct+ · cv+	Recombinant	94	R
v · ct · cv+	Recombinant	3	R x2
v+ · ct+ · cv	Recombinant	5	R x2
	Total	1448	284

RF = 284/1448 = 19.6%

PRACTICE

1. The following table shows data from a cross (ABC x abc) examining three genes (a, b, and c). Calculate the recombination frequency for A and B

a. 20%
b. 32%
c. 37%
d. 9.8%

Genotype	Offspring	A C	A B	B C
A B C	320			
a b c	276			
a B C	145			
A b c	152			
A b C	43			
a B c	34			
A B c	9			
a b C	12			

2. The following table shows data from a cross examining three genes (a, b, and c). Calculate the recombination frequency for A and C

a. 32%
b. 37%
c. 20%
d. 9.8%

Genotype	Offspring	A C	A B	B C
A B C	320			
a b c	276			
a B C	145			
A b c	152			
A b C	43			
a B c	34			
A B c	9			
a b C	12			

3. The following table shows data from a cross examining three genes (a, b, and c). Calculate the recombination frequency for B and C

a. 20%
b. 32%
c. 37%
d. 9.8%

Genotype	Offspring	A C	A B	B C
A B C	320			
a b c	276			
a B C	145			
A b c	152			
A b C	43			
a B c	34			
A B c	9			
a b C	12			

4. The following table shows data from a cross examining three genes (a, b, and c). Determine the order of genes
    a. A B C
    b. B C A
    c. C A B

Genotype	Offspring	A C	A B	B C
A B C	320			
a b c	276			
a B C	145			
A b c	152			
A b C	43			
a B c	34			
A B c	9			
a b C	12			