

AIM: HOW DO WE MAP DISTANCES FOR GENES THAT ARE LINKED?

DEFINE RECOMBINANT (FROM H/O)

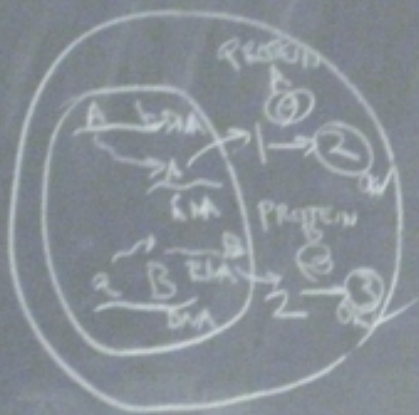
REVIEW CONVENTIONS OF NOTATION (ALSO FROM H/O)

YESTERDAY, I GAVE YOU A BACK CROSS THAT SHOWED SEPARATION OF 2 MUTATED ALLELES OVER A RECESSIVE BACKGROUND. THIS IS SIMILAR TO A COMPLEMENTATION TEST IN THAT IT WOULD SHOW IF MUTATIONS WERE IN SAME OR DIFF GENES.



1 $\xrightarrow{A}$ 2 $\xrightarrow{B}$ 3

FOR GENE PRODS
THAT CONTROL
A PATHWAY
RESCUED BY
TRANS EXPRESSION,
HERE'S HOW IT
LOOKS IN A CELL



GRFFB1
MORGAN'S BIG DISCOVERY
ON DEVIATION FROM I.A.

DONT
CRASH
X

KEY

pr = PURPLE EYE Vg = VESTIGIAL WING
pr⁺ = NORM EYE Vg⁺ = NORM WING

* YOU DONT KNOW WHERE THE
GENES ARE YET.

pr/pr · Vg/Vg × pr⁺/pr⁺ · Vg⁺/Vg⁺
(pr · Vg) (pr⁺ · Vg⁺)

pr⁺/pr · Vg⁺/Vg =

NOW
pr⁺/pr · Vg⁺/Vg × pr/pr · Vg/Vg
F1 (DITHYB♀) (TESTER♂)

131
BIG DISCOVERY
VARIATION FROM I.A.

DON'T
ERASE
ANY
OF
THIS

RED EYE $Vg = \text{VESTITIAL WING}$
 NORMAL EYE $Vg^+ = \text{NORMAL WING}$

DON'T KNOW WHERE THE
GENES ARE YET.

$Vg/Vg \times pr^+/pr^+ \cdot Vg^+/Vg^+$
 $(pr^+ \cdot Vg)$ gametes

$pr^+/pr \cdot Vg^+/Vg = F1$

$Vg^+/Vg \times pr/pr \cdot Vg/Vg \rightarrow$
 (TESTER $\rightarrow$), RECESSIVE
 DIHYB (BACK)

FIRST, LET'S ASSUME NO LINKAGE
(IA ONLY)

	$pr^+ Vg^+$	$pr^+ Vg$	$pr Vg^+$	$pr Vg$
TESTER $pr Vg$	1	1	1	1

HOW MANY WERE FOUND? NOT THIS RATIO!!

NOW, LET'S ASSUME LINKAGE.

pr^+	pr^+	pr	pr
Vg^+	Vg	Vg^+	Vg

1:1 RATIO,
2 POP'S
EXPECTED

POT, MO
INSTE
PARENT 1
PARENT 2
NEITHER
PARENT 1
NOR
PARENT 2
ALL
 pr^+
 pr

FIRST, LET'S ASSUME NO LINKAGE
(IA ONLY)

	pr^+vg^+	pr^+vg	$pr \cdot vg^+$	$pr \cdot vg$
TESTER $pr \cdot vg$	1	1	1	1

HOW MANY WERE FOUND? NOT THIS RATIO!!

NOW, LET'S ASSUME LINKAGE -

	pr^+	pr		
	$+$	$+$		
	vg^+	vg		
	$+$	$+$		
pr	pr^+	pr	pr^+	pr
$+$	$+$	$+$	$+$	$+$
vg	vg^+	vg	vg^+	vg
	$+$	$+$	$+$	$+$

1 : 1 RATIO,
2 POP'S
EXPECTED

BUT, MORE
INSTEAD

PARENT 1

PARENT 2

NEITHER
PARENT 1
NOR
PARENT 2

ALLE

pr^+

pr

BUT, MORGAN DIDNT SEE THIS...
INSTEAD, HE SAW, WORKING W/ STURTEVANT:

PARENT 1	$Pr^+ \cdot Vg^+$ / TESTER	1339	} PARENTAL DITYPES (PD)
PARENT 2	$Pr \cdot Vg$ / TESTER	1195	
NEITHER PARENT 1 NOR PARENT 2	$Pr^+ \cdot Vg$ / TESTER	151	} NONPARENTAL DITYPES (NPD) (RE COMBINANTS)
	$Pr \cdot Vg^+$ / TESTER	154	
		2839 TOT	

ALLELIC CONFORMATION IS PREDICTED TO BE:

$Pr^+ \quad Vg^+$

$Pr \quad Vg$

(cis)

SAME STRAND

WHY?

B/C PARENTAL TYPES INDICATE THIS.

GOING BACK TO THE DRAWING BOARD:

$pr^+/pr \cdot vg^+/vg \text{♀} \times pr/pr \cdot vg/vg \text{♂}$

TESTER

↓ F2 YIELDS

$pr^+ \cdot vg^+ / \text{TESTER}$	157	> NONPARENTAL
$pr \cdot vg / \text{TESTER}$	146	
$pr^+ \cdot vg / \text{TESTER}$	965	> PARENTAL
$pr \cdot vg^+ / \text{TESTER}$	1067	

2335

BUT THIS TIME, CONFORM IN IS TRANS

$\left. \begin{array}{l} pr^+ \quad vg \\ pr \quad vg^+ \end{array} \right\} \text{TRANS - OPP STRAND}$
 BASED ON PARENTS

FROM THE BASE

* TWO NON TOT

* TWO REC < 5

→ R.F.
→ R.F.

FROM THIS, WE PREDICT
THE TRANS CONFORMATION $\frac{pr^+ \quad vg}{pr \quad vg^+}$
BASED ON 2 CLASSES WE SEE:

- * TWO EQUALLY FREQUENT NONRECOMBINANT CLASSES TOTALING $> 50\%$ = PARENTAL
- * TWO EQUALLY FREQUENT RECOMBINANT CLASSES TOTALING $< 50\%$ = NONPARENTAL

→ R.F. $< 50\%$ DIAGNOSES LINKAGE
→ R.F. $\geq 50\%$ - LINKAGE RULED OUT
SEE GRIFF 13.7.1

- RECALL THAT CROSSOVERS
ARE TO "HEAL" GENES
AT THE 4-CHROMATID
STAGE OF PROPHASE I

- RECOMBINATION CAN BE
USED TO MAP DISTANCE
B/W 2 GENES:

$$\underset{\text{MAP UNIT}}{1 \text{ M. U.}} = \underset{\text{RECOMB FREQ}}{\text{R. F. OF } 1\%}$$

- 3-POINT TESTCROSS IS
A TOOL FOR ESTABLISHING
DISTANCE B/W AND
POSITION OF GENES

GRIFF

KEY V =
CV
CT

"DOT"
GENE
CRITI
DO A
FIRST
IS TH

GRIFF 140

KEY V = VERMILION EYE
CV = CROSSVEINLESS WING
CT = CUT WING

"DOT" $\Rightarrow$ INDICATES UNKNOWN
GENE SEQUENCE... IT IS
CRITICAL THAT YOU
DO NOT ASSUME YOUR
FIRST WRITTEN ORDER
IS THE TRUE GENE ORDER.

V⁺/
GAMETES

V / V⁺.

V. CV

V⁺. C

V. CV

V⁺. C

$V^+/V^+ \cdot CV/CV \cdot ct/ct \times V/V \cdot CV^+/CV^+ \cdot ct^+/ct^+$
 GAMETES ($V^+ \cdot CV \cdot ct$) $\downarrow$ ($V \cdot CV^+ \cdot ct^+$)

F1 TRIHYB = $V/V^+ \cdot CV/CV^+ \cdot ct/ct^+$

THEN ... TESTCROSS

$V/V^+ \cdot CV/CV^+ \cdot ct/ct^+ \times V/V \cdot CV/CV \cdot ct/ct$
 F1 TESTEE TESTER MALE

LIST ASSUMED GAMETES ...

$V \cdot CV^+ \cdot ct^+$	580
$V^+ \cdot CV \cdot ct$	592
$V \cdot CV \cdot ct^+$	45
$V^+ \cdot CV^+ \cdot ct$	40
$V \cdot CV \cdot ct$	89
$V^+ \cdot CV^+ \cdot ct^+$	94
$V \cdot CV^+ \cdot ct$	3
$V^+ \cdot CV \cdot ct^+$	5

<u>V AND CV</u>	<u>V AND ct</u>	<u>CV AND ct</u>
> P A	R R R R	R R
R R R R	R R R R	R R

} HIGH
 } INTER
 } FREQ 1
 } INTER
 } FREQ 2
 } RARE

TOTAL
V AND
268
V AND
191
CV AND
93

ct^+/ct^+
 ct^{δ}
 HIGH
 INTER FREQ 1
 INTER FREQ 2

TOTALS
V AND CV 268
V AND Ct 191
CV AND Ct 93

CALCULATIONS

V, CV
 GAMETES OF PARENTS
 OF F1 ARE (BASED
 ON OUTCOMES AND F1 PARENTS)
 $V^+ \cdot CV$ AND $V \cdot CV^+$

$\therefore \text{RECOMB} = 45 + 40 + 89 + 94 = 268$
 $\text{RF} = 18.5\% \left(\frac{268}{1448} \right)$
 V, Ct

$\therefore \text{RECOMB} = V \cdot Ct \text{ AND } V^+, Ct^+$
 (B/C PARENTAL GAMETES
 BEFORE F1 ARE $V^+ \cdot Ct$ AND
 $V \cdot Ct^+$)
 $\text{RECOMB} = 89 + 94 + 3 + 5 = 191$
 $\text{RF} = 13.2\%$

Ct
 RECOMB AND C
 (B/C PA
 GAMETE
 F1 AR
 AND C
 $\therefore \text{RECO}$
 $45 + 40$
 $\text{RF} =$

Ct, CV

RECOMB = $CV \cdot Ct^+$

AND $CV^+ \cdot Ct$

(B/C PARENTAL
GAMETES BEFORE
F1 ARE $CV \cdot Ct$
AND $CV^+ \cdot Ct^+$)

$\therefore$ RECOMB =

$$45 + 40 + 3 + 5 = 93$$

$$RF = 6.4\%$$

ORDER: $V \leftarrow 13.2 \rightarrow Ct \leftarrow 6.4 \rightarrow CV$

MAPPING $\Rightarrow 18.5 \approx 13.2 + 6.4$ "ROUGHLY"

LOW #'S ARE DUE TO DCO'S (DOUBLE CROSSES)

COUNT EACH 2X DUE TO DCO EVENT

REWRITE CROSS BASED ON COUNTS:

$V \times Ct \times CV / V \times Ct \times CV$
 $V \times Ct \times CV / V \times Ct \times CV$

ESTAB. DISTANCES... WE KNOW GENE ORDER IS DIFF BUT HOW?

Ct IS BETWEEN V AND CV , BUT NO PRECISE CHROMOS. POSITION.

$$13.2 + 6.4 = 19.6$$

GO BACK TO 1ST CALCULN

$$45 + 40 + 89 + 94 + 3 + 3 + 5 + 5 =$$

$$284 / 1448 = 19.6\%$$

$V \times Ct \times$

Ct

TAL

BEFORE

$V \times Ct$

$(Ct \times)$

=

$$45 = 93$$

$$4\%$$