Key

Genetics
Linkage Problem Set
~~April 21, 2008~~ 2009

Textbook ~~problems 10, 12, 13, 14, 15, 16~~ Chapter 5 - Insights & Solutions p135, probs 1-8 14, 16.

3-point Linkage Problem

1. In *Drosophila*, curly wings are recessive to straight wings, hour-glass shaped eyes are recessive to round eyes, and short antennae are recessive to long antennae. All of the above characteristics are controlled by genes located on chromosome # 4 (not the X- chromosome).

Symbols
c = curly
h = hourglass
s = short

a. Show 3 possible crosses for a 3-point cross involving the 3 characteristics above, making sure that the first 2 criteria for successful mapping are satisfied. (Your goal is two produce 2 flies that can mate and whose offspring will show evidence of recombination between each of the genes.)

* All would have to mate with ♂ $\frac{chs}{chs}$ (see part b)

① $\frac{c\ h\ s}{c\ h\ s} \times \frac{+\ +\ +}{+\ +\ +}$ ♀ ♂ → $\frac{c\ h\ s}{+\ +\ +}$ ♀

② $\frac{c\ +\ s}{c\ +\ s} \times \frac{+\ h\ +}{+\ h\ +}$ → $\frac{c\ +\ s}{+\ h\ +}$ ♀

③ $\frac{c\ +\ +}{c\ +\ +} \times \frac{+\ h\ s}{+\ h\ s}$ → $\frac{c\ +\ +}{+\ h\ s}$ ♀

* other possibilities

b. You note in the F2 offspring of a 3-point cross set up by Dr. Super that :

<u>the 2 most common types of flies are</u>

hour-glass eyes
and
curly wings/short antennae

+ h + and c + s

<u>the least common types of flies are</u>

wild type
and
curly wings/short antennae/ hour-glass eyes

+ + + and c h s

Diagram the way in which Dr. Super set up the 3-point cross and indicate which gene appears to be in the middle of the other 2?

Since the most common phenotypes are + h + and c + s, these are the parental combinations. It follows that double crossovers are least - consistent with observed genotype. ♀ $\frac{+\ h\ +}{c\ +\ s}$ × ♂ $\frac{c\ h\ s}{c\ h\ s}$

Parental (NCO): $\frac{+\ h\ +}{c\ h\ s}$ and $\frac{c\ +\ s}{c\ h\ s}$ | DCO $\frac{c\ h\ s}{c\ h\ s}$ and $\frac{+\ +\ +}{c\ h\ s}$

2. In mouse, 3 genes are linked on chromosome 7 in the following order.

--------z----------c---------g----
21 cM 7 cM

A. In theory, if you looked at 1000 offspring from a 2-point cross set up to map distance between z and g, how many recombinant offspring might you expect?

21 cM + 7 cM = 28 cM

• 28 x 1000 = 280 recombinants

B. In practice, would you expect **exactly that many, fewer** or **more** recombinants? Explain.

We might expect fewer recovered recombinants since DCO in the region would end up looking NCO, for any 2 genes.

z c g
+ X + X + — do not appear to have recombined at all.

C. In a 3 point cross you examined 1000 F1 offspring and observed 9 double crossover offspring. What phenomenon are you observing? Describe it quantitatively.

z ——— c ——— g
.21 .07
SCO SCO

Expected DCO = (.21)(.07) x1000 = 14.7

Since fewer DCO were seen than expected we are observing interference.

$C = \frac{\text{observed}}{\text{expected}}$

$I = 1 - C$

$I = 1 - \frac{9}{14.7} = 0.388$

Positive interference = + 0.388