

## F12 Biol 322

### Answers to most of the Quiz#1 Study Problems

1. This mating is equivalent to a dihybrid self cross

$p^+$  = wt allele  $p$  = progeria

$cf^+$  = wt allele  $cf$  = cystic fibrosis

a. child is either  $p/p; cf^+/-$  OR  $p^+/-; cf/cf$

Add the probabilities of each possibility together:

$$(1/4)(3/4) + (3/4)(1/4) = 6/16$$

b. First kid is  $p^+/-; cf/cf$

1/3 chance kid is  $p^+ p^+$

(remember that the knowledge that the child is does not have progeria restricts the possible genotypes)

2. This mating is equivalent to a trihybrid self cross.

Since the traits are assorting independently you can figure out the probability for each gene and then multiply the probabilities together.

a.  $(1/4)^3$

b. Kid is A-B-C- or A/-; B/-; C/-

$$1/3(AA) \times 2/3(Bb) \times 2/3(Cc) = 4/27$$

3.

$d^+$  = WT allele of *dpy-11* gene

$d$  = mutant allele of *dpy-11* gene

$u^+$  = WT allele of *unc-32* gene

$u$  = mutant allele of *unc-32* gene

$$F1 = u^+ u d^+ d$$

Pick F2s that are  $u^+ - d d$ . If genes are assorting independently, 2/3 of these animals will be het for the *unc* gene

## 5. Allele symbols:

$l^+$  = WT allele of *lon-1* gene

$l$  = mutant allele of *lon-1* gene

$r^+$  = WT allele of *rol-3* gene

$r$  = mutant allele of *rol-3* gene

$b^+$  = WT allele of *bli-15* gene

$b$  = mutant allele of *bli-15* gene

## Parental generation

$r^+ r^+ ; X^{l^+ b^+} / O \quad \text{♂} \quad \mathbf{X} \quad r r ; X^{l^+ b} / X^{l^+ b} \quad \text{♀}$

or

$r^+ r^+ ; l^+ b^+ / O \quad \text{♂} \quad \mathbf{X} \quad r r ; l^+ b / l^+ b \quad \text{♀}$

## F1 generation

blister:  $r^+ r ; X^{l^+ b} / O \quad \text{♂}$

wildtype:  $r^+ r ; X^{l^+ b} / X^{l^+ b} \quad \text{♀}$

[self progeny have same genotype as parental hermaphrodites]

6. a. The ratio of wildtype to mutant was 15:1 rather than the 3:1 ratio expected from a single gene trait.

A = wt a = loss-of-function mutation

B = wt b = loss-of-function mutation

A-B- wildtype aaB- wildtype A-bb wildtype aabb = piggy

b. Hypothesis: piggy is a single gene trait with 2 alleles that have a simple dominance relationship where the wildtype allele is completely dominant to the mutant allele.

Mendel's principle of segregation (and random fertilization of gametes) predicts a 3:1 ratio of WT to piggy worms. chi square value = 6 df = 1 p ~ 0.014

The deviation observed from the expected 3:1 ratio has a relatively low probability of being due to chance if the single gene hypothesis is correct. This deviation from expected is considered statistically significant since  $p < 0.05$ .

c. The chi square analysis does not prove or disprove either hypothesis (two gene versus one gene specification of the trait). The single gene hypothesis may be correct and the deviation due to, for example, underscoring of the piggy animals because they are smaller and mature more slowly than wild-types. Additional experiments would need to directly

address this issue. If the single gene hypothesis is correct and the deviation due to scoring biases, then just looking at a larger sample size will not help. But, directly addressing the scoring bias by reexamining experimental set up or execution and looking at a larger sample size would be a good follow-up.

7. a. For each of the ten progeny of a heterozygote:

3/4 chance it shows the dominant phenotype

1/4 chance it shows the recessive phenotype (which would reveal the genotype of the parent)

$(3/4)^{10} = 0.056$  = chance that all ten progeny of a heterozygous plant will show the dominant phenotype = *1 in 18* hets will produce only dominant progeny and be miscoded as homozygotes for the dominant allele

b. Deducing the genotypes of the wild-type F2s

c. Homozygotes for the dominant allele will breed true and always be scored correctly: 0.33 of F2s with dominant phenotype scored correctly

$1 - 0.056$  = probability that *at least one* progeny of a heterozygous plant is homozygous recessive = 0.944

2/3 [fraction of F2 with dominant phenotype that are het]  $[(3/4)^{10}] = 0.0375$  scored incorrectly

scored as RR = 0.33 (correct) + 0.0375 (incorrect) = 0.37

scored as Rr = 0.67 (0.944) = 0.63

0.63 Rr to 0.37 RR = 1.7 to 1