

# 7.012 Genetics Section Problems

For each set of data below, determine the genotype of the parents in cross 1. Where it applies, indicate which phenotypes are dominant and which are recessive.

## Mice I

a) cross 1: red-eyed mouse \_\_\_\_\_  $\times$  white-eyed mouse \_\_\_\_\_

gives F<sub>1</sub>: all red-eyed

cross 2: red-eyed F<sub>1</sub>  $\times$  red-eyed F<sub>1</sub>

gives F<sub>2</sub>: 36 red-eyed  
13 white-eyed

b) cross 1: long-eared mouse \_\_\_\_\_  $\times$  short-eared mouse \_\_\_\_\_

gives F<sub>1</sub>: 12 long-eared  
10 short-eared

cross 2: long-eared F<sub>1</sub>  $\times$  long-eared F<sub>1</sub>

gives F<sub>2</sub>: 36 long-eared  
13 short-eared

## Flowers

cross 1: blue-flowered plant \_\_\_\_\_  $\times$  white-flowered plant \_\_\_\_\_

gives F<sub>1</sub>: all pale-blue-flowered

cross 2: pale-blue F<sub>1</sub>  $\times$  pale-blue F<sub>1</sub>

gives F<sub>2</sub>: 27 blue  
49 pale-blue  
24 white

## Blood Type

a) cross 1: person, type A blood \_\_\_\_\_  $\times$  person with type B \_\_\_\_\_

gives F<sub>1</sub>: all type AB blood

cross 2: type AB F<sub>1</sub>  $\times$  type AB F<sub>1</sub>

gives F<sub>2</sub>: 2 type A  
4 type AB  
1 type B

## Blood Type, continued

b) cross 1: type A blood \_\_\_\_\_  $\times$  type B \_\_\_\_\_

gives F<sub>1</sub>: 2 type A blood  
3 type AB blood  
1 type B blood  
2 type O blood

## Mice II

a) cross 1: tail-less mouse \_\_\_\_\_  $\times$  normal mouse \_\_\_\_\_

gives F<sub>1</sub>: 10 tail-less  
9 normal

cross 2: tail-less F<sub>1</sub>  $\times$  tail-less F<sub>1</sub>

gives F<sub>2</sub>: 10 normal  
21 tail-less  
9 dead

b) cross 1: blue-eyed, long-toothed mouse  $\times$  brown-eyed, short-toothed mouse

\_\_\_\_\_  $\times$  \_\_\_\_\_

gives F<sub>1</sub>: all blue-eyed, short-toothed

cross 2: blue-eyed, short-toothed F<sub>1</sub>  $\times$  blue-eyed, short-toothed F<sub>1</sub>

gives F<sub>2</sub>: 92 blue-eyed short-toothed  
31 blue-eyed long-toothed  
29 brown-eyed short-toothed  
9 brown-eyed long-toothed

## Plants

cross 1: tall, green plant \_\_\_\_\_  $\times$  short, yellow plant \_\_\_\_\_

gives F<sub>1</sub>: 20 tall green  
20 short green

cross 2: tall, green  $\times$  short, yellow (different plants than (b))

gives F<sub>1</sub>: 19 tall green  
21 tall yellow

# Solutions to Genetics Section Problems

## Mice I

a) Cross 1: red eyes X white eyes gives all red eyes – a likely model is that eye color is controlled by one gene that has 2 alleles resulting in two phenotypes, red eyes and white eyes. The red eyed phenotype is likely to be dominant. Therefore, choose appropriate symbols (one letter per gene, capital letter for allele with dominant phenotype):

R - red allele. Dominant phenotype of red eyes.

r - white allele. Recessive phenotype of white eyes.

Cross 1 is then: RR X rr ----> all Rr (all red eyes).

Cross 2 is then: Rr X Rr ----> 3:1 red:white.

The predictions agree with the data.

b) Cross 1: long ears X short ears gives some long and some short ears – a likely model is that ear length is controlled by one gene with 2 alleles resulting in two phenotypes, long ears and short ears. From this data, we cannot determine which allele has the dominant phenotype.

Cross 2: long ears X long ears gives some long and some short ears – a likely model is that long ears is the dominant phenotype. Therefore, the appropriate symbols are:

L - long ears .

l - short ears .

Cross 1 is then: Ll X ll ----> 1:1 long ears : short ears

Cross 2 is then Ll X Ll ----> 3:1 long ears : short ears

The predictions agree with the data.

## Flowers:

Cross 1: blue flowers X white flowers gives all pale blue flowers – a plausible model is that color is controlled by one gene with 2 alleles, resulting in blue and white flowers, and that neither phenotype is dominant. This is an example of codominance.

BB - blue phenotype.

B'B' - white phenotype.

BB' - pale blue phenotype.

therefore:

Cross 1 is then: BB X B'B' ----> all BB', pale blue flowers .

Cross 2 is then: BB' X BB' ----> 1:2:1 BB, blue flowers : BB', pale blue flowers : B'B',white flowers. The predictions agree with the data.

## Blood Type

Blood type is determined by one gene that has three alleles:

$I^A$  - allele associated with the A phenotype, co-dominant with the B phenotype

$I^B$  - allele associated with the B phenotype, co-dominant with the A phenotype

$I^O$  - allele associated with the O phenotype, recessive to both the A and B phenotype

a) Cross 1 is then:  $I^AI^A \times I^BI^B \rightarrow$  all type  $I^AI^B$

Cross 2 is then:  $I^AI^B \times I^AI^B \rightarrow$  1:2:1 types A:AB:B (note skewed ratio with small number of progeny)

b) Cross 1 is then:  $I^AO \times I^BO \rightarrow$  1:1:1:1 types A:B:AB:O (note skewed ratio with small number of progeny)

The predictions agree with the data.

## Mice II:

a) Tail-lessness and lethality are controlled by one gene with two alleles:

T allele - dominant tail-less phenotype; recessive lethal phenotype

t allele - recessive normal-tail phenotype; dominant viable phenotype

therefore:

TT - tail-less and dead

Tt - tail-less and alive

tt - normal-tail and alive

Cross 1 is then: Tt X tt  $\rightarrow$  1:1, Tt (tail-less) : tt (normal)

Cross 2 is then: Tt X Tt  $\rightarrow$  1:2:1 normal:tail-less:dead

The predictions agree with the data.

b) eye color is determined by one gene with two alleles:

B - dominant blue-eye phenotype

b - recessive brown eye phenotype

tooth length is determined by one gene with two alleles:

T - dominant short-tooth phenotype

t - recessive long tooth phenotype

Cross 1 is then: BBss X bbSS  $\rightarrow$  all BbSs

Cross 2 is then: BbSs X BbSs  $\rightarrow$  9:3:3:1 (B\_S\_): (B\_ss): (bbS\_): (bbss)

The predictions agree with the data.

## Plants

Height is determined by one gene with two alleles where the tall phenotype is dominant over the short phenotype.

Color is determined by one gene with two alleles where the green phenotype is dominant over the yellow phenotype.

Cross 1 is then: TtGG X ttgg  $\rightarrow$  1:1 tall and green (TtGg) : short and yellow (ttGg)

Cross 2 is then: TTGg X ttgg  $\rightarrow$  1:1 (tall and green (TtGg) : tall and yellow (Ttgg))