

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: $RR \times rr \rightarrow$ all Rr (all red eyes).

Cross 2 is then: $Rr \times Rr \rightarrow$ 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: $Ll \times ll \rightarrow$ 1:1 long ears : short ears

Cross 2 is then $Ll \times Ll \rightarrow$ 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 Partial or Semi or Incomplete dominance.

BB - blue phenotype.

B'B' - white phenotype.

BB' - pale blue phenotype.

therefore:

Cross 1 is then: $BB \times B'B' \rightarrow$ all BB', pale blue flowers.

Cross 2 is then: $BB' \times BB' \rightarrow$ 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: $I^A I^A \times I^B I^B \rightarrow$ all type $I^A I^B$

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

b) Cross 1 is then: $I^A I^O \times I^B I^O \rightarrow$ 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: $Tt \times tt \rightarrow$ 1:1, Tt (tail-less) : tt (normal)

Cross 2 is then: $Tt \times Tt \rightarrow$ 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: $BBss \times bbSS \rightarrow$ all BbSs

Cross 2 is then: $BbSs \times BbSs \rightarrow$ 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: $TtGg \times ttgg \rightarrow$ 1:1 tall and green ($TtGg$) : short and yellow ($ttGg$)

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