Genetics Practice Problems

We will work through the following problems for the beginning of this lab period.

The problems can be found in the Genetics chapter of *A Problems Approach to Introductory Biology (APAIB)*. They are:

- 1.1.2
- 1.3.4
- 1.3.5
- 1.3.7
- 1.4.1

(1.1.2) For each of the following sets of data, give a genetic model that explains all the data. A genetic model contains the following:

- the number of genes and alleles involved, e.g., "tooth shape is controlled by one gene with two alleles."
- a statement of which phenotype is dominant and which is recessive.
- symbols denoting each allele such that uppercase letters are associated with the dominant phenotype and lowercase letters are associated with the recessive phenotype.
- the genotypes of all the individuals involved.

a)   Cross 1: Red-eyed mouse X white-eyed mouse

    gives F_1:   all red-eyed

Cross 2: Red-eyed F_1 X red-eyed F_1

    gives F_2:   36 red-eyed
                     13 white-eyed

<u>allele</u>   <u>contribution to phenotype</u>

b)   Cross 1: Long-eared mouse X short-eared mouse

                gives F_1:   12 long-eared
                                    10 short-eared

        Cross 2: Long-eared F_1 X long-eared F_1

                gives F_2:   34 long-eared
                                    14 short-eared

        allele   contribution to phenotype

(1.3.4) Consider the flower color in a hypothetical plant. Make a genetic model that fits the following data and give the genotypes of the different groups of individuals.

        Cross 1: Blue-flowered plant **X** white-flowered plant

                gives F_1:   all pale-blue-flowered

        Cross 2: Pale-blue F_1 pale-blue F_1

                gives F_2:   27 blue
                                    49 pale-blue
                                    24 white

        allele   contribution to phenotype

(1.3.5)   You are studying eye color in an imaginary fly. You know that eye color is controlled by a single gene.

Cross 1:
You cross two green-eyed flies and get some green-eyed and some white-eyed offspring.

a) Given only cross 1, generate the simplest genetic model that fits the data.
    i) Define your allele symbols clearly.

    <u>allele</u>   <u>contribution to phenotype</u>

    ii) What are the genotypes of the two parents of cross 1?

    iii) What is/are the genotype(s) of the green-eyed offspring?

You find some red-eyed flies and decide to try to figure out what's going on with this new color.

Cross 2:
    red-eyed **X** white-eyed gives half red-eyed and half green-eyed offspring

b) Now give a genetic model that fits **all the data from both crosses**:
Note: your answers to parts (a) and (b) need not be the same.

    i) Define your allele symbols clearly.

    <u>allele</u>   <u>contribution to phenotype</u>

    ii) What are the genotypes of the two parents of **<u>cross 2</u>**?

Blood type in humans is controlled by one gene with 3 alleles. For Bio 111, you should use the following symbols when working blood-type problems in humans.

Allele Contribution to phenotype
I^A type A (co-dominant with I^B; dominant to i)
I^B type B (co-dominant with I^A; dominant to i)
i   type O (recessive to all)

Complete the table below using this information:

Genotype	Phenotype
$I^A I^A$	
$I^B I^B$	
ii	
$I^A I^B$	
I^A i	
I^B i	

(1.3.7) Consider the following situation: a male (**George, type B blood**) and a female (**Sallie, type A blood**) claim that a newborn (**Fred, type B blood**) is their son.

a) Given this information, is it possible that George and Sallie are Fred's parents? (explain briefly)

b) You learn that George's father has type A blood and his mother has type B blood. Given this information, is it possible that George and Sallie are Fred's parents? (explain briefly)

c) On further investigation, you find that George's sister has type O blood. Given this information, is it possible that George and Sallie are Fred's parents? (explain briefly)

d) Finally, you discover that both of Sallie's parents are type AB. Given this information, is it possible that George and Sallie are Fred's parents? (explain briefly)

(1.4.1) Consider the following X-linked trait in a hypothetical mammal with XX/XY sex-determination where red eyes are dominant to white eyes.

allele   contribution to phenotype

a) Predict the expected offspring from the following crosses:

    i) White-eyed female **X** red-eyed male.

    ii) Red-eyed female **X** white-eyed male (there are two possibilities here; give both).

Consider the following Z-linked trait in a hypothetical bird with ZZ/ZW sex determination where red eyes are dominant to white eyes.

b) Predict the expected offspring from the following crosses:

i) White-eyed female **X** red-eyed male (there are two possibilities here; give both).

ii) Red-eyed female **X** white-eyed male.