

## CHAPTER 2 BASIC MENDELIAN GENETICS

### ✠ Problem 1

Is it possible by breeding procedures alone to detect the presence of a gene if it exists in only one allelic form? Explain.

### ✠ Problem 2

- What does Mendel's principle of independent assortment predict about the genetic composition of the gametes from an organism heterozygous for two different genes (where A & a are alleles of one gene and B & b alleles of another gene)?
- Under what conditions is Mendel's principle of independent assortment invalid?
- Draw a set of diagrams that illustrate the physical basis of Mendel's principle of independent assortment.

### ✠ Problem 3

- What genetic phenomenon that is important in diploids cannot usually be investigated in haploids?
- What are some of the advantages of genetic analysis of haploid organisms over that of diploid ones?
- Can you think of an advantage of using a diploid organism?

### ✠ Problem 4

In Klingons, one gene determines hair texture while another determines whether the individual will have a sagittal crest.

- K** = curly klingon hair (dominant)
- k** = silky earthling hair (recessive)
- S** = large sagittal crest (dominant)
- s** = smooth, flat earthling forehead (recessive)

Kayless is half human, half Klingon with a genotype of **KkSs**. He is mated to Lieutenant Worf's sister, who is also **heterozygous** for both alleles.

Dr. Beverly Crusher wants to better examine the genotypes of their offspring. Help her out by answering the following questions:

- Set up a Punnett square for this **dihybrid cross**.
- What are the 4 possible **phenotypes** that may result from this mating?  
(Include a description of both hair and forehead for each phenotype.)
- What is the expected phenotypic ratio of a dihybrid cross?
- Are Kayless and his mate more likely to see an actual ratio close to that predicted if they have 3 children or 30? Why? In other words, what effect does larger sample size have on observed phenotypic ratios?

### ✠ Problem 5

A plant with orange spotted flowers was grown in the greenhouse from a seed collected in the wild. The plant was self-pollinated and gave rise to the following progeny: 91 orange spotted 31 yellow spotted 32 orange plain, and 10 yellow

plain. What can you conclude about the dominance relationships of plain vs. spotted? Of orange vs. yellow? What can you conclude about the genotype of the original "orange-spotted" plant?

**✠ Problem 6**

The wild-type fruitfly *Drosophila melanogaster* has straight wings and long bristles. Mutant strains have been identified that have curled wings or short bristles. The genes for these two traits are autosomal.

**CAREFULLY EXAMINE THE DATA IN THE TABLE BELOW.**

- a. Which traits are dominant?
- b. Are the genes for these traits on different chromosomes?
- c. For each cross, give the genotypes of the parents. Fill in the table below using the following allele designations:

$w^+$  = straight wings,  $w$  = curled wings     $b^+$  = long bristles,  $b$  = short bristles

Genotype of parents:

Cross #1.....

Cross #2.....

Cross #3.....

Cross #4.....

Cross #5.....

Number of progeny in each class (160 total for each cross):

Cross	Parental phenotype		<u>Number of progeny in each class (160 total for each cross):</u>			
	male	X female	<u>straight wings</u> <u>long bristles</u>	<u>straight wings</u> <u>short bristles</u>	<u>curled wings</u> <u>long bristles</u>	<u>curled wings</u> <u>short bristles</u>
#1	straight, short	straight, short	30	90	10	30
#2	straight, long	straight, long	120	0	40	0
#3	curled, long	straight, short	40	40	40	40
#4	straight, short	straight, short	40	120	0	0
#5	curled, short	straight, short	20	60	20	60

**✠ Problem 7**

The fungi *Neurospora* is a haploid organism that has a transient diploid state. Two strains of fungus are mated. One strain has blue, thick mycelium and the other has gray, thin mycelium. The gene controlling mycelium color assort independently

from the gene controlling mycelium thickness. The progeny segregating from this cross will be:

- a. 9/16 blue, thick; 3/16 blue, thin; 3/16 gray, thick; 1/16 gray, thin
- b. 1/4 blue, thick; 1/4 blue, thin; 1/4 gray, thick; 1/4 gray, thin
- c. 1/2 blue, thick; 1/2 gray, thin
- d. Hey, this is a bogus question because haploid fungi can't undergo sexual reproduction.
- e. Not enough information given to draw a conclusion.

**✦ Problem 8**

In tomatoes two alleles of one gene determine the character difference of purple vs. green stems and two alleles of another gene determine the character difference of "cut" vs. "potato" leaves. Examine the data shown below.

For each cross, write out the genotype of each parent. Be sure to define your allele symbols:

mating	parental phenotype	Number of progeny			
		purple, cut	purple, potato	green, cut	green potato
1	purple, cut x green, cut	321	101	310	107
2	purple, cut x purple, potato	219	207	64	71
3	purple, cut x green, cut	722	231	0	0
4	purple, cut x green, potato	404	0	387	0
5	purple, potato x green, cut	70	91	86	77

Mating	Parent 1	Parent 2
1		
2		
3		
4		
5		

### ✠ Problem 9

- a.** Although the alteration of meiosis and fertilization is common to all sexually reproducing organisms, the timing of these two events in the life cycle of the organisms varies. There are three basic types life cycles, which differ with respect to whether the multicellular organism is haploid or diploid. Briefly describe the three types.
- b.** You find a previously undescribed plant species in which some individuals are *green* and others are *blue* in color. Only one of the two phases of the life cycle, the diploid or the haploid, is conspicuous (large enough to be seen and studied). After crossing the two true-breeding strains, you find that the progeny plants are *green* and *blue* in equal numbers.

Which type of life cycle is characteristic of plants? Is the conspicuous phase of this species diploid or haploid? Why?

### ✠ Problem 10

In a certain eukaryotic species one strain is able to synthesize the amino acid tryptophan and another is not. These strains reproduce themselves true to type. The progeny of a cross between them consists of both types, in the following distributions:

tryptophan synthesizers	85
tryptophan nonsynthesizers	89

- a.** Are the two strains diploid or haploid? Explain.
- b.** What genetic principle do these results support?
- c.** How would you assay the ability to synthesize tryptophan? In other words, how would you assess the phenotype of the progeny?

### ✠ Problem 11

A testcross of an F1 results in a eight phenotypic classes present in equal numbers.

- a.** How many genes are involved?
- b.** What other information is given by these results?