## BIOLOGY 100 SOLUTIONS TO PROBLEMS

## **MENDELIAN GENETICS**

1. In summer squash, white fruit color is dominant over yellow. If a plant homozygous for white fruit color is crossed with a plant homozygous for yellow fruit color, what will the F1 generation be like? If these F1 plants are self fertilized and 213 offspring are recovered, approximately how many will be white, and how many of these might be expected to breed true?

Parental phenotypes Parental genotypes	White WW	х	Yellow ww	(W = domin	ant allele; v	v = recessive allele)	
Parental gametes	(W)		(w)				
F1 generation phenotype F1 generation genotype		Whit Ww	-				
F1 generation gametes (each individual)		(W),	(w)				
F2 phenotypes and genotypes:		(F1 gar	netes):	(W)	(w)		
			(W)	White WW	White Ww		

From the above Punnett square, 3/4 of the offspring will be white. Out of a total of 213 offspring, we expect 160 to be white  $(3/4 \times 213)$ .

The above Punnett square also tells us that 1/4 of the offspring will be true breeding white (i.e., homozygous dominant). We expect 53 offspring to be white true-breeders ( $1/4 \times 213$ ).

(w)

White

Ww

Yellow

ww

2. A white-fruited squash plant when crossed with a yellow-fruited plant produces offspring about half of which are white and half of which are yellow in fruit color. What are the genotypes of the parent plants?

In problems that ask for the genotype of parents, follow these simple steps: a) write down the phenotypes of each parent; b) based on these phenotypes, write down what you know about their phenotypes (remember that an expressed recessive trait means that an individual is homozygous recessive); c) look for recessive offspring; they are homozygous recessive and must have inherited a recessive allele from each parent; d) fill in the missing genotype information based on the above evidence.

Phenotypes of parents	White	Х	Yellow
Initial determination of parental genotypes	W?		WW

F1 generation phenotypes F1 generation genotypes

Since there are recessive offspring, the white parent must have carried the recessive allele and therefore had the heterozygous genotype, Ww. As a check, a cross of Ww x ww produces 50% white and 50% yellow in the F1 generation.

3. In addition to color in summer squash, it is known that disk shape is dominant to sphere shape. A cross between a plant with white disk fruit and one with yellow sphere fruits yielded 25 plants with white disk, 26 plants with white sphere, 24 with yellow disk, and 25 with yellow sphere fruits. If the white disk parent is self-fertilized, what proportion of its offspring will have yellow disk fruits?

See comments in question #2 for determining genotypes of parents. In this question, the offspring phenotypes have a ratio of roughly 1:1:1:1.

Phenotypes of parents		White-Disk	x Yellow-Sphe		ere
Initial determination of parental genotypes		W?D?	wwdd		
F1 generation phenotypes	White-Disk	White-Sphere		ow-Disk	Yellow-Sphere
F1 generation genotypes	W?D?	W?dd		wwD?	Wwdd

Since there are F1 offspring that are homozygous recessive for both traits, the white-disk parent must have carried the recessive allele for each trait. The white-disk parent is heterozygous for each gene: WwDd.

Crossing the White-Disk parental plant with itself will produce the following:

Phenotypes of parents Parental genotypes Parental gametes F1 genotypes:	(WD),	White-Disk WwDd (Wd), (wD)		White-Di WwDo (WD), (Wd), (	ł
i i genecypeer	(WD)	(Wd)	(wD)	(wd)	
(WE	) WWDD	WWDd	WwDD	WwDd	
(Wc	) WWDd	WWdd	WwDd	Wwdd	
(wD	) WwDD	WwDd	wwDD	wwDd	
(wd	) WwDd	Wwdd	wwDd	wwdd	

Of the 16 offspring combinations, 3 will be Yellow-Disk (wwD-). These individuals can be found in the three shaded blocks within the Punnett square. 3/16 of the offspring will have the Yellow-Disk phenotype.

4. What are the parental genotypes of a white sphere plant and a white disk plant which, when crossed, yield 3/8 white disk, 3/8 white sphere, 1/8 yellow disk, and 1/8 yellow sphere offspring?

See comments in question #2 for determining genotypes of parents.

Phenotypes of parents Initial determination of parental genotypes		White-Disk W?D?	х	White-Spher W?dd	e	
F1 generation phenotypes F1 generation genotypes Since there are offspring that are	White-Disk W?D?	White-Spher W?dd		Yellow-Disk wwD?	Yellow-Sphere wwdd	
Since there are offspring that are homozygous recessive for both traits, each parent must have at least one recessive allele for each trait. Therefore, the White-Disk parent has the genotype of WwDd and the White-Sphere parent has the genotype of Wwdd.						

5. What are the parental genotypes of a white sphere plant and a yellow disk plant which, when crossed, yield all white disk plants?

See comments in question #2 for determining genotypes of parents.

Phenotypes of parents	White-Sphere	х	Yellow-Disk
Initial determination of parental genotypes	W?dd		wwD?
F1 generation phenotypes	all V	Vhite-D	visk
F1 generation genotypes		W?D?	

No recessive phenotype appears in the F1 generation. This means that <u>both</u> parents cannot have the recessive allele for each trait. Therefore the parental genotypes must be WWdd x wwDD. As a check, this cross produces all individuals with a genotype of WwDd.