Genetics Problems

1. A rooster with gray feathers is mated with a hen of the same phenotype. Among their offspring, 15 chicks are gray, 6 are black, and 8 are white.

- What is the simplest explanation for the inheritance of these colors in chickens?
- What offspring would you predict from the mating of a gray rooster and a black hen?

2. In some plants, a true-breeding, red-flowered strain gives all pink flowers when crossed with a white-flowered strain: RR (red) x rr (white) ---> Rr (pink). If flower position (axial or terminal) is inherited as it is in peas what will be the ratios of genotypes and phenotypes of the generation resulting from the following cross: axial-red (true-breeding) x terminal-white? What will be the ratios in the F_2 generation?

3. Flower position, stem length, and seed shape were three characters that Mendel studied. Each is controlled by an independently assorting gene and has dominant and recessive expression as follows:

Character	Dominant	Recessive
Flower position	Axial (A)	Terminal (a)
Stem length	Tall (T)	Dwarf (t)
Seed shape	Round (R)	Wrinkled (r)

If a plant that is heterozygous for all three characters were allowed to self-fertilize, what proportion of the offspring would be expected to be as follows: (Note - use the rules of probability (and show your work) instead of huge Punnett squares)

a. homozygous for the three dominant traits
2. homozygous for the three recessive traits
3. heterozygous
4. homozygous for axial and tall, heterozygous for seed shape

4. A black guinea pig crossed with an albino guinea pig produced 12 black offspring. When the albino was crossed with a second one, 7 blacks and 5 albinos were obtained.

- What is the best explanation for this genetic situation?
- Write genotypes for the parents, gametes, and offspring.

5. In sesame plants, the one-pod condition (P) is dominant to the three-pod condition (p), and normal leaf (L) is dominant to wrinkled leaf (l) . Pod type and leaf type are inherited

independently. Determine the genotypes for the two parents for all possible matings producing the following offspring:

a. 318 one-pod normal, 98 one-pod wrinkled
2. 323 three-pod normal, 106 three-pod wrinkled
3. 401 one-pod normal
4. 150 one-pod normal, 147 one-pod wrinkled, 51 three-pod normal, 48 three-pod wrinkled
5. 223 one-pod normal, 72 one-pod wrinkled, 76 three-pod normal, 27 three-pod wrinkled

6. A man with group A blood marries a woman with group B blood. Their child has group O blood.

- What are the genotypes of these individuals?
- What other genotypes and in what frequencies, would you expect in offspring from this marriage?

7. Color pattern in a species of duck is determined by one gene with three alleles. Alleles H and I are codominant, and allele i is recessive to both. How many phenotypes are possible in a flock of ducks that contains all the possible combinations of these three alleles?

8. Phenylketonuria (PKU) is an inherited disease caused by a recessive allele. If a woman and her husband are both carriers, what is the probability of each of the following?

a. all three of their children will be of normal phenotype
2. one or more of the three children will have the disease
3. all three children will have the disease
4. at least one child out of three will be phenotypically normal

(*Note*: Remember that the probabilities of all possible outcomes always add up to 1)

9. The genotype of F1 individuals in a tetrahybrid cross is AaBbCcDd. Assuming independent assortment of these four genes, what are the probabilities that F_2 offspring would have the following genotypes?

a. aabbccdd
2. AaBbCcDd
3. AABBCCDD
4. AaBBccDd
5. AaBBCCdd

10. In 1981, a stray black cat with unusual rounded curled-back ears was adopted by a family in California. Hundreds of descendants of the cat have since been born, and cat fanciers hope to develop the "curl" cat into a show breed. Suppose you owned the first curl cat and wanted to develop a true breeding variety.

- How would you determine whether the curl allele is dominant or recessive?
- How would you select for true-breeding cats?
- How would you know they are true-breeding?

11. What is the probability that each of the following pairs of parents will produce the indicated offspring (assume independent assortment of all gene pairs?

a. AABbCc x aabbcc ----> AaBbCc
2. AABbCc x AaBbCc -----> AAbbCC
3. AaBbCc x AaBbCc -----> AaBbCc
4. aaBbCC x AABbcc ----> AaBbCc

12. Karen and Steve each have a sibling with sickle-cell disease. Neither Karen, Steve, nor any of their parents has the disease, and none of them has been tested to reveal sickle-cell trait. Based on this incomplete information, calculate the probability that if this couple should have another child, the child will have sickle-cell anemia.

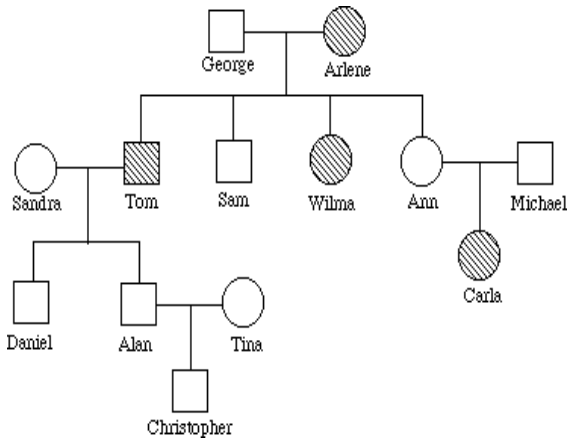
13. Imagine that a newly discovered, recessively inherited disease is expressed only in individuals with type O blood, although the disease and blood group are independently inherited. A normal man with type A blood and a normal woman with type B blood have already had one child with the disease. The woman is now pregnant for a second time. What is the probability that the second child will also have the disease? Assume both parents are heterozygous for the "disease" gene.

14. In tigers, a recessive allele causes an absence of fur pigmentation (a "white tiger") and a cross-eyed condition. If two phenotypically normal tigers that are heterozygous at this locus are mated, what percentage of their offspring will be cross-eyed? What percentage will be white?

15. In corn plants, a dominant allele I inhibits kernel color, while the recessive allele i permits color when homozygous. At a different locus, the dominant gene P causes purple kernel color, while the homozygous recessive genotype pp causes red kernels. If plants heterozygous at both loci are crossed, what will be the phenotypic ratio of the F_1 generation?

16. The pedigree below traces the inheritance of alkaptonuria, a biochemical disorder. Affected individuals, indicated here by the filled-in circles and squares, are unable to

break down a substance called alkapton, which colors the urine and stains body tissues. Does alkaptonuria appear to be caused by a dominant or recessive allele? Fill in the genotypes of the individuals whose genotypes you know. What genotypes are possible for each of the other individuals?

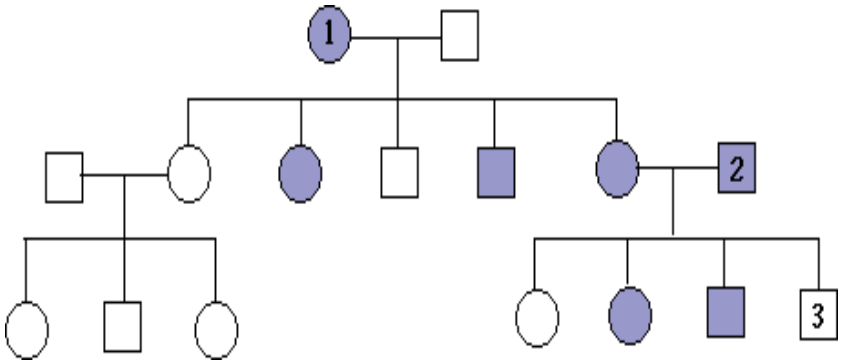


17. A man has six fingers on each hand and six toes on each foot. His wife and their daughter have the normal number of digits (5). Extra digits is a dominant trait. What fraction of this couple's children would be expected to have extra digits?

18. Imagine you are a genetic counselor, and a couple planning to start a family came to you for information. Charles was married once before, and he and his first wife had a child who has cystic fibrosis. The brother of his current wife Elaine died of cystic fibrosis. What is the probability that Charles and Elaine will have a baby with cystic fibrosis? (Neither Charles nor Elaine has the disease)

19. In mice, black color (B) is dominant to white (b). At a different locus, a dominant allele (A) produces a band of yellow just below the tip of each hair in mice with black fur. This gives a frosted appearance known as agouti. Expression of the recessive allele (a) results in a solid coat color. If mice that are heterozygous at both loci are crossed, what will be the expected phenotypic ratio of their offspring?

20. The pedigree below traces the inheritance of a vary rare biochemical disorder in humans. Affected individuals are indicated by filled-in circles and squares. Is the allele for this disorder dominant or recessive? What genotypes are possible for the individuals marked 1, 2, and 3.



Solutions