

Extra credit genetics problems. SHOW YOUR WORK IN CLEARLY-RECOGNIZABLE STEPS. NO STEPS, NO POINTS. You may type (preferred) or hand-write answers. If you hand-write answers, they must be easily legible – if I come to a word I cannot read easily, I will stop grading the paper at that point. If you work these in groups, all must be able to work through each question independently, because they may end up on a quiz or exam.

1. Two cats are mated. One of the parent cats is long-haired (recessive allele). The litter which results contains two short-haired and three long-haired kittens. What does the second parent look like, and what is its genotype?
2. Mr. and Mrs. Jones have six children. Three of them have attached earlobes (recessive) like their father, and the other three have free earlobes like their mother. What are the genotypes of Mr. and Mrs. Jones and of their numerous offspring?
3. Mr. and Mrs. Anderson both have tightly curled hair. (The hair form gene shows incomplete dominance. There are two alleles, curly and straight. The heterozygote has wavy hair.) The Andersons have a child with wavy hair. Mr. Anderson accuses Mrs. Anderson of being unfaithful to him. Is he necessarily justified? Why or why not?
4. In certain portions of the Jewish population, there is a genetic disease called Tay Sachs disease, which is fatal to infants within the first five years of life. This disease is caused by a recessive allele of a single gene. Why does this disease persist, even though it is invariably fatal long before the afflicted individual reaches reproductive age? (In other words, why doesn't the allele for Tay Sachs disease simply disappear?)
5. Elizabeth is married to John, and they have four children. Elizabeth has a straight nose (recessive) and is able to roll her tongue (dominant). John is also able to roll his tongue, but he has a convex (Roman) nose (dominant). Of their four children, Ellen is just like her father, and Dan is just like his mother. The other children — Anne, who has a convex nose, and Peter, who has a straight nose — are unable to roll their tongues. Please answer the following questions about this family.
 - What are the genotypes of Elizabeth and John?
 - Elizabeth's father was a straight-nosed roller, while her mother was a convex-nosed non-roller. What can you figure out about their genotypes?
 - John's father was a straight-nosed roller, while his mother was a convex-nosed roller. What can you determine about their genotypes?
6. Earl has normal color vision, while his wife Erma is colorblind. Colorblindness is an X-linked trait, and the normal allele is dominant to the colorblindness allele. If they have a large family, in what ways should the colorblindness trait affect their children?
7. In cats, there is a coat color gene located on the X chromosome. This gene has two alleles—orange and black. A heterozygous cat has tortoiseshell color (a splotchy mixture of orange and black). Predict the genotypic and phenotypic frequencies among the offspring of the following crosses. Pay careful attention to the genders of the offspring.
 - Black female X Orange male
 - Orange female X Black male
 - Tortoiseshell female X Black male
 - Tortoiseshell female X Orange male
8. In a case in Spokane, Washington, a young woman accused a soldier of being the father of her child. The soldier, of course, denied it. The soldier's lawyer demanded that blood types be taken to prove the innocence of his client. The following results were obtained: Alleged father - Type O; Mother - Type A; Child - Type AB. The court found the soldier guilty on the basis of the woman's remarkable memory for dates and details that apparently eliminated all other possible fathers.
 - What are the possible genotypes for these three people?
 - Do you agree with the court's decision? Why or why not?

Also do questions 15, 16, 17, 23 and 26 from the text (pp. 238-239).

15. The smooth feathers on the back of the neck in pigeons can be reversed by a mutation to produce a “crested” appearance in which feathers form a distinctive spike at the back of the head. A pigeon breeder examined offspring produced by a single pair of non-crested birds and recorded the following: 22 non-crested and 7 crested. She then made a series of crosses using offspring from the first cross. When she crossed two of the crested birds, all 20 of the offspring were crested. When she crossed a non-crested bird with a crested bird, 7 offspring were non-crested and 6 were crested.

- For these three crosses, provide genotypes for parents and offspring that are consistent with these results.
- Which allele is dominant?

16. 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: 88 orange with spots, 34 yellow with spots, 32 orange with no spots, and 8 yellow with no spots. What can you conclude about the dominance relationships of the alleles responsible for the spotted and unspotted phenotypes? For the orange and yellow phenotypes? What can you conclude about the genotype of the original plant that had orange, spotted flowers?

17. As a genetic counselor, you routinely advise couples about the possibility of genetic disease in their offspring based on their family histories. This morning you met with an engaged couple, both of whom are phenotypically normal. The man, however, has a brother who died of Duchenne-type muscular dystrophy, an X-linked condition that results in death before the age of 20. The allele responsible for this disease is recessive. His prospective bride, whose family has no history of the disease, is worried that the couple's sons or daughters might be afflicted.

- How would you advise this couple?
- The sister of this man is planning to marry his fiancée's brother. How would you advise this second couple?

23. Two mothers give birth to sons at the same time in a busy hospital. The son of couple 1 is afflicted with hemophilia A, which is a recessive X-linked disease. Neither parent has the disease. Couple 2 has a normal son even though the father has hemophilia A. The two couples sue the hospital in court, claiming that a careless staff member swapped their babies at birth. You appear in court as an expert witness. What do you tell the jury? Make a diagram that you can submit to the jury.

26. Recall that hemophilia is an X-linked recessive disease. If a woman with hemophilia had children with a man without hemophilia, what is the chance that their first child will have the disease? What is the chance that their first child will be a carrier?