

Advanced Genetics Practice Problems – Beyond Mendel

Part 1: Incomplete Dominance

1. What is incomplete dominance? How does this affect the phenotype of the heterozygotes?
2. Japanese Four O' clock Flowers show an incomplete dominance for Color. When an offspring has both the Red and the White allele, it appears Pink (Rr).
 - a. Show a cross between a Purebred Red (RR) and a Purebred White (rr) flower. What is the Genotype and Phenotype ratio?
 - b. Show a cross between two Pink Japanese Four O'clock Flowers. What is the Genotype and Phenotype Ratio?
3. In Horses the valuable Palomino (Gold) color is the result of a cross between a purebred Chestnut (brown) and a purebred Cremello (off-white).
 - a. Use a Punnett Square to show a cross between 2 Palomino Horses. What is the Genotype and Phenotype Ratios of this cross?
 - b. What are the Genotype and Phenotype Ratios for a cross between a Cremello horse and a Palomino horse.
 - c. If you were a horse breeder that wanted only Palomino offspring, what parent cross would ensure this result? Use a Punnett Square to justify your answer.

Part 2: Co-Dominance

4. What is co-dominance? How does this affect the phenotype of the heterozygotes?
5. Roan (RW) is a color of cattle in which both Red (R) and White (W) hairs are present due to Co dominance.
 - a. What are the phenotype and genotype ratios of offspring produced by a Roan bull and a Red cow?
 - b. What are the phenotype and genotype ratios of offspring produced by a Roan bull and a White cow?
 - c. What are the phenotype and genotype ratios of offspring produced by a Roan bull and a Roan cow?
 - d. If you had a Roan bull, what are all the possible genotypes from this bull's parents?

Part 3: Multiple Allele Traits

6. What are multiple allele traits?
7. Blood Type is determined by 3 different alleles A, B and O. A and B are co-dominant, while O is recessive. Possible blood types are A, B, AB and O. A man with O type blood marries a woman with AB type blood. What are the possible blood types of their offspring?

8. Vincent has type A blood and his mother has type O blood. Christine has type B blood and her father has type O blood. Vincent and Christine are not related.
- What are Vincent and Christine's genotype?
 - What are the possible genotypes of Christine's mother? Vincent's father?
 - Suppose Christine and Vincent got married. What is the probable phenotype ratio for their offspring?

Part 4: Sex-Linked Traits

9. What is a sex-linked trait?
10. In drosophila (fruit flies) white eye is recessive X-linked trait (X^r). Red eyes are normal and dominant (X^R). A white eyed female is crossed with a red eye male.
- What phenotypic ratios would be obtained in the F1 generation (include sex in phenotype)?
 - If a male and female from the F1 generation in problem #10 mate, what would be the F2 phenotype ratio?
11. Red-green color blindness is caused by a sex-linked recessive allele. A colorblind man marries a woman whose father was colorblind. What is the probability of them having a colorblind girl? A colorblind boy?
12. Pseudohypertrophic muscular dystrophy is a disorder that causes gradual deterioration of the muscles. It is seen only in boys born to apparently normal parents and usually results in death in the early teens.
- Is pseudohypertrophic muscular dystrophy caused by a dominant or recessive allele?
 - Is its inheritance sex-linked or autosomal? How do you know?
 - Explain why this disorder is seen only in boys and never in girls?

Part 5: Environmental Influence on Phenotype

13. In science, there is often a debate about "nature vs. nurture." What is this debate really about? What is meant by "nature?" What is meant by "nurture?"
14. Describe three types of environmental factors that can influence phenotype.
15. Give an example of one human trait that has been affected by the environment and explain which environmental factors most influence this trait.

