

Genetics Problems

1. In one experiment, Mendel crossed a pea plant that bred true for axial flowers with a pea plant that bred true for terminal flowers. All the F_1 plants had axial flowers. Which is the recessive trait? Explain your answer.
2. Green pod color is a dominant allele in pea plants (**G**). If two plants with green pods are crossed, some of the offspring are have yellow pods. What are the possible genotypes of the parents?
3. In poultry, rose comb is controlled by a dominant allele and its recessive allele controls single comb.
 - a. Give the genotype and phenotype produced from crossing a pure-breeding rose comb chicken with a pure-breeding single comb chicken.
 - b. Give the results of the backcross of the F_1 hybrid with both pure-breeding parents.
4. If black fur color is controlled by dominant allele (B) and brown by its recessive allele (b), give the genotypes of the parents and offspring 9of a cross of black, male with a brown female that produces 1/2 black offspring and 1/2 brown offspring.
5. In garden peas, one pair of alleles controls the height of the plant and a second pair of allele controls flower color. The allele for tall (T) is dominant to the allele for dwarf (t), and the allele for purple (P) is dominant to the allele for white (p).
 - a. A tall plant with purple flowers crossed with a dwarf plant with white flowers produces 1/2 tall with purple flowers and 1/2 tall with white flowers. What is the genotype of the parents?
 - b. A tall plant with white flowers crossed with a dwarf plant with purple flowers produces all tall offspring with purple flowers. What is the genotype of the parents?
 - c. A tall plant with purple flowers crossed with a dwarf plant with white flowers produces 1./4 tall purple, 1/4 tall white, 1/4 dwarf purple and 1./4 dwarf white. What is the genotype of the parents?
 - d. A tall plant with white flowers crossed with a dwarf plant with purple flowers produces 1/4 tall purple, 1./4 tall white, 1/4 dwarf purple, and 1.4 dwarf white. What is the genotype of the parents?
 - e. A tall plant with purple flowers crossed with a a tall plant with white flowers produces 3/8 tall purple, 1/8 tall white, 3/8 dwarf purple, and 1/8 dwarf white. What is the genotype of the parents?
 - f. A tall purple crossed with a tall purple produces 3/4 tall purple and 1.4 tall white. What is the genotype of the parents?
6. In horses, black coat color is influenced by the dominant allele (B) and chestnut coat color is influenced by the recessive allele (b). Trotting gait is due to a dominant gene (T) and pacing gait to the recessive allele (t). If a homozygous black trotter is crossed to a chestnut pacer
 - a. What is the appearance of the F_1 and F_2 generations?
 - b. Which phenotype will be most common? Which genotype will be most common?
 - c. Which of the potential offspring will be certain to breed true?
7. In horses the allele for black coat (B) is dominant to the allele for chestnut coat (b) and the allele for trotting gait (T) is dominant to the allele for running gait (t). Predict the phenotype ratio for the offspring of a heterozygous black heterozygous trotting horse with a chestnut running horse.



8. In horses the allele for black coat (B) is dominant to the allele for chestnut coat (b) and the allele for trotting gait (T) is dominant to the allele for running gait (t). Predict the phenotype ratio for the offspring of a homozygous black heterozygous trotting horse with a chestnut running horse.
9. Crosses between a yellow rat and a yellow rat always produce yellow rats. Crosses between a white rat and a white rat always produce white rats. The alleles affect the same aspect of coat color. The crosses of a white with a yellow rat produce a cream rat. What happens if you cross 2 cream rats?
10. In sweet peas, genes C and P are necessary for colored flowers. In the absence of either (___pp or cc___) or both (cc pp), the flowers are white. What will be the color of the offspring of the crosses and in what proportions for the following?
 - a. CcPp x ccpp
 - b. CcPp x CcPp
 - c. CcPP x Ccpp
 - d. Ccpp x ccpP

11. In Labrador retrievers coat color is determined by 2 genes that sort independently:
 - melanin production (B for black is dominant to b for brown)
 - melanin deposition (E for deposition is dominant to e for no deposition)

Yellow Labrador retrievers may be homozygous dominant, homozygous recessive, or heterozygous for pigment production but are homozygous recessive for melanin deposition. Chocolate Labrador retrievers are homozygous recessive for melanin production but may be homozygous dominant or heterozygous for melanin deposition.

Black Labrador retrievers may be homozygous dominant or heterozygous for melanin production and for melanin deposition.

- a. Write all possible genotypes for yellow, chocolate, and black Labrador retrievers:
 Yellow_____ Chocolate_____ Black_____
- b. A male and female chocolate Labrador retriever were mated and had a litter of 12 puppies. Eight of the puppies were yellow. What were the genotypes of the parents?
 Parent genotypes_____
- c. How many of the other puppies were chocolate and how many were black? (Please show your work!)
 Chocolate_____ Black_____

12. In cats, coat color shows lack of dominance. If cats with brown coat color are crossed with cats with yellow coat color, all the F₁ cats are calico. Is it possible for the calico cats to breed true? Explain using a diagram.



Table 6: χ^2 Values

		P (probability)								
d. f. *		.95	.90	.80	.70	.50	.30	.10	.05	.01
1		.004	.016	.064	.148	.455	1/03	2.71	3.84	6.64
2		.103	.211	.446	.713	1.38	2.41	4.60	5.99	9.20
3		.352	.584	1.00	1.42	2.37	3.66	6.25	7.82	11.30

*degrees of freedom = 1 for monohybrid cross
= 3 for dihybrid cross

χ^2 Data from <http://www.richland.cc.il.us/james/lecture/m170/tbl-chi.html>

χ^2 calculator: http://www.physics.csbsju.edu/stats/chi-square_form.html

You are looking for the difference to be INSIGNIFICANT!

P values above .05 are INSIGNIFICANT (not significant)

This means that actual values DO NOT differ from expected values.

13. A student counts 1920 kernels of corn from the F_2 progeny of a dihybrid cross. The observed number of progeny in each phenotypic class was 998 purple wrinkled; 410 purple smooth; 376 yellow wrinkled; and 136 yellow smooth. Use the table below to determine the expected number, the χ^2 value, and the probability of the observed values not differing significantly from the expected 9:3:3:1 ratio. Do the data fit the model?

Analysis Corn Ears (dihybrid cross)

$$\chi^2 = \frac{(a_1-e_1)^2}{e_1} + \frac{(a_2-e_2)^2}{e_2} + \frac{(a_3-e_3)^2}{e_3} + \frac{(a_4-e_4)^2}{e_4}$$

	Purple~Wrinkled	Purple~Smooth	Yellow~Wrinkled	Yellow~smooth	Total
Actual Number	a_1	a_2	a_3	a_4	
Expected Number	e_1	e_2	e_3	e_4	

14. You are given an ear of corn from the F_2 generation from the same cross above. You count a total of 420 kernels - 242 purple wrinkled, 84 purple smooth, 70 yellow wrinkled, and 24 yellow smooth. Do these data reflect a 9:3:3:1 ratio?

Analysis Corn Ears (dihybrid cross)

$$\chi^2 = \frac{(a_1-e_1)^2}{e_1} + \frac{(a_2-e_2)^2}{e_2} + \frac{(a_3-e_3)^2}{e_3} + \frac{(a_4-e_4)^2}{e_4}$$

	Purple~Wrinkled	Purple~Smooth	Yellow~Wrinkled	Yellow~smooth	Total
Actual Number	a_1	a_2	a_3	a_4	
Expected Number	e_1	e_2	e_3	e_4	

