

Genetics Practice Problems

1. In pea plants, tall (T) is dominant to dwarf (t). Show the cross between a heterozygous tall and a dwarf plant. What are the expected phenotypes and in what proportion? *50% tall 50% short 1:1 ratio*

2. Show the cross between two heterozygous tall plants. What are the expected phenotypes and in what proportion? *75% tall 25% short 3:1 ratio*

3. In humans, tongue rolling is a dominant trait, those with the recessive condition cannot roll their tongues. Bob can roll his tongue, but his mother could not. He is married to Sally, who cannot roll her tongue. What is the probability that their first born child will not be able to roll his tongue? *50%*

4. In goats, a recessive gene causes the goats to "faint" when they are startled. A farmer breeds two goats (that have never fainted) and their first offspring faints two days after its birth. What must the parent's genotypes have been? Show the cross to prove it. *Both must be hybrid (heterozygous)*

5. In guinea pigs, short hair is dominant to long hair. Also in guinea pigs, black eyes are dominant to red eyes. A male guinea pig that is heterozygous for both traits is crossed with a female that is long haired and red eyed. What are the expected phenotypes of their offspring and in what proportion? *25% Short Black 25% Long Black 25% Short Red 25% Long Red 1:1:1:1*

6. If both guinea are heterozygous for both traits, what are the expected phenotypes of their offspring and in what proportion? *9:3:3:1 9 short black 3 short red 3 long black 1 long red*

7. In mice, the spinning behavior is caused by a dominant gene that effects the mouse's equilibrium. This gene is lethal if two alleles are present. Two "spinning mice" are mated together. Show the cross. What are the phenotypes of the offspring and in what proportion. (Be sure to eliminate any offspring that do not survive.)

1/3 Normal

2/3 Spinning

1:2 Ratio for survivors

Helpful Tips

1. Only use X's and Y's when the problem tells you it is sex linked.
2. You may need to use trial and error to figure out parental genotypes.
3. Reference your notes.
4. Make a "key" of genotypes and phenotypes if you're stuck.

8. Normal leg size, characteristic of the Kerry type of cattle, is produced by the homozygous genotype DD. Short-legged Dexter cattle possess the heterozygous genotype Dd. The homozygous genotype dd is lethal, producing grossly deformed stillbirths called "bulldog calves". In addition, the presence of horns in cattle is governed by the recessive gene at another locus, gene p. The polled condition (absence of horns) is produced by its dominant allele, P. What phenotypic ratios are expected in the progeny of a cross between 2 true dihybrid cattle?

6 Dexter Polled : 3 Kerry Polled : 2 Dexter Horned : 1 Kerry Horned 6:3:2:1

9. In mice, there is a set of multiple alleles of the gene for albinism. Four of these alleles, listed in order of decreasing amount of colour in the hair of homozygotes are:

- C: full colour wild type;
- C^D = extreme dilution.
- C^{ch} ; chinchilla
- c: albino

	C	C^{ch}
C^D	$C^D C$	$C^D C^{ch}$
c	Cc	$C^{ch} c$

Diagram a cross between a wild type mouse heterozygous for chinchilla and an extreme dilution mouse heterozygous for albinism. Assume that each allele is dominant to those below it in the list. The gene is not sex linked. $C C^{ch} \times C^D c$

10. In a certain cactus, prickly spines can be two pronged or one pronged. If a true breeding one-pronged cactus is crossed with a true breeding two-pronged cactus, the F1 generation has a mixture of spines, some are two-pronged, some are one-pronged.

- a. Is this an example of co-dominance or incomplete dominance?
- b. Show the F2 generation (a cross between the two F1's). What are the phenotypes of the offspring and in what proportion.

25% 2 pronged : 50% mixed pronged : 25% 1 prong

1:2:1

11. In this same cactus, purple flowers are dominant to yellow flowers. A cactus that has both two-pronged and one-pronged spines has yellow flowers. It is crossed with a two-pronged cactus with purple flowers (heterozygous). What are the phenotypes of the offspring and in what proportion?

25% purple 2-prong : 25% purple mixed prong : 25% yellow 2-prong : 25% yellow mixed prong

1:1:1:1

12. Coat color in cats is a co-dominant trait & is also located on the X chromosome. Cats can be black, yellow or calico. A calico cat has black and yellow splotches. A female calico cat is crossed with a male black cat. What are the phenotypes of the offspring and in what proportion.

50% black
25% calico
25% yellow

2:1:1

13. A nurse at a hospital removed the wrist tags of three babies in the maternity ward. She needs to figure out which baby belongs to which parents, so she checks their blood types. Using the chart below, match the baby to its correct parents. Show the crosses to prove your choices.

Parents	Blood Types	Baby	Blood type
Mr. Hartzel	O		
Mrs. Hartzel	A	Jennifer Peach	O
Mr. Simon	AB	Rebecca Hartzel	A
Mrs. Simon	AB	Holly Simon	B
Mr. Peach	O		
Mrs. Peach	O		

$abcde$
 $aBCde$
 $abCdE$
 $aBCdE$
 $ABCdE$
 $AbCdE$
 $ABCde$
 $AbCde$

14. What are all the gametes that can be produced from an individual with the genotype $AaBbCCddEe$? = 8

15. In addition to colour, also located on the X chromosome of a cat is a gene that codes for deafness. This gene is recessive. A black female cat that is heterozygous for deafness (Dd) is crossed with a yellow male cat that is not deaf. Show the cross. What are the phenotypes of the offspring and in what proportion. **50% Calico Nondeaf**
25% Black Nondeaf
25% Black Deaf
2:1:1
Hint: place two letters on the X chromosome in your cross.

16. In domestic fowl, there are two pairs of genes affecting the comb. When homozygous for the recessive forms of both genes, the chicken will have a single (normal) comb. A dominant allele of one of these genes, P , causes a pea comb. A dominant allele of the other, R , causes a rose comb. However, if a chicken has at least one of both dominants $P_R_$, the comb will be walnut -- a result of the combined action of both dominant genes. Show the expected offspring of a cross between two walnut combed chickens, both heterozygous for both genes.

9 Walnut : 3 Rose : 3 Pea : 1 Normal 9:3:3:1

17. In humans, the gene for albinism (a) is recessive to the allele for normal pigmentation (A). There is another gene, B , which produces "blaze", a white forelock of hair. The presence of the gene for albinism (all white hair), would totally mask the presence of the blaze gene--it is epistatic to blaze. A man with blaze had an albino mother. He marries an albino woman who had parents with normal hair colour. Show the combinations of children which they may have and the proportions of each. *** Must assume the man's father had no blaze**

50% albino 25% normal 25% blaze 2:1:1

18. Optic atrophy (blindness due to atrophy of the optic nerve) occurs as a result of the action of a recessive sex-linked gene. A woman with optic atrophy marries a normal man. Their first child, a boy, has optic atrophy. Show the genotypic and phenotypic ratio to be expected in future children.

$X^a X^a \times X^A Y$
 Genotype = 50% $X^a X^A$ (heterozygous O. atrophy) = carriers.
 50% $X^a Y$
 1:1
 Phenotype: 50% female normal
 50% O. atrophic males
 1:1