Learning Genetics Can Be Fun

1. For Labrador retrievers, black fur is dominant to yellow. Explain how two black dogs can have different genotypes. Could a black dog have the same genotype as a yellow dog?

2. Cystic fibrosis is caused by a recessive allele, c. Explain how two normal parents can produce a child with this disorder.

3. A pea plant with round seeds is crossed with a pea plant that has wrinkled seeds. For the cross, indicate each of the following:
a) the genotype of each of the parents if the round seed plant is heterozygous.
b) the gametes produced by the parents
c) the genotypes and phenotypes of the F_1 generation
d) the F_2 generation if two round plants from the F_1 generation were crossed

4. Long stems are dominant over short stems for pea plants. Determine the phenotypic and genotypic ratios of the F_1 offspring from the cross pollination of a heterozygous long stem plant with a short stem plant.

5. A pea plant with a tall phenotype is pollinated by a short plant, and the seeds of the first generation hybrid produce 327 tall plants and 321 short plants. Give the genotypes of all the plants.

6. In a certain species of plant, one purebred variety has hairy leaves and another pure variety has smooth leaves. A cross of the 2 varieties produces offspring that all have smooth leaves. Predict the ratio of phenotypes in the F_2 generation.

7. For Dalmatian dogs, the spotted condition is dominant to non-spotted.
a) Using a Punnett square, show a cross between two heterozygous parents.
b) A spotted female Dalmatian dog is mated to an unknown male. If the female has six pups, three spotted and three non-spotted, what are the genotype and phenotype of the unknown male?

8. In horses, the trotter characteristic is dominant to the pacer characteristic. A male trotter mates with three different females, and each female produces a foal. The first female, a pacer, gives birth to a foal that is a pacer. The second female, also a pacer, gives birth to a foal that is a trotter. The third female, a trotter, gives birth to a foal that is a pacer. Determine the genotypes of the male, all three females, and the three foals sired.

9. The allele that causes albinism (p) is recessive to the allele for normal pigmentation (P). A normal woman whose father is an albino marries an albino man whose parents are both normal. They have three children, two normal, one albino. Give the genotype for each individual.

10. In fruit flies, straight wings is dominant over curly. Show how you would determine if a straight winged fly were heterozygous or homozygous?

11. PKU is a recessive disorder. Suppose two people who were heterozygous for PKU married and had a child. What is the probability that the child will have PKU?

12. Imagine for hair color that B gives brown hair and b gives blonde hair. Use a Punnett square to determine the following in a cross of two heterozygous parents.
a) What are the chances of the offspring being homozygous brown haired?
b) What are the chances of the offspring having blonde hair?
c) What are the chances of the offspring being heterozygous brown haired?
d) What is the genotypic ratio?
e) What is the phenotypic ratio?
f) Is there a heterozygous blonde haired offspring? Why?
g) If curly hair is dominant to straight hair, what letters will we use to show these genes?
h) A heterozygous curly haired male marries a straight haired female. What are their genotypes?
i) What would be the gametes for the male parent?
j) What would be the gametes for the female parent?
k) What are the chances of the offspring being homozygous curly haired?
l) What are the chances of the offspring having straight hair?
m) What are the chances of the offspring being heterozygous curly haired?
n) What is the genotypic ratio?
o) What is the phenotypic ratio?
p) Is there a heterozygous straight haired offspring? Why?

13. In guinea pigs, black coat color (B) is dominant to white (b), and short hair length (S) is dominant to long (s). Indicate the genotypes and phenotypes from the following crosses:
a) Homozygous for black, heterozygous for short hair guinea pig crossed with a white, long hair guinea pig.
b) Heterozygous for black and short hair guinea pig crossed with a white, long hair guinea pig.
c) Homozygous for black and long hair crossed with a heterozygous black and short hair guinea pig.
d) For each of these crosses (a, b, and c), give the probability that an offspring will have:
(i) black coat, long hair
(ii) black coat, short hair
(iii) white coat, long hair

14 Black coat color (B) in cocker spaniels is dominant to white coat color (b). Solid coat pattern (S) is dominant to spotted pattern (s). The pattern arrangement is located on a different chromosome than the one for color, and its gene segregates independently of the color gene. A male that is black with a solid pattern mates with three females. The mating with female A, which is white, solid, produces four pups: two black, solid, and two white, solid. The mating with female B, which is black, solid, produces a single pup, which is white, spotted. The mating with female C, which is white, spotted, produces four pups: one white, solid; one white spotted; one black, solid; one black, spotted. Indicate the genotypes of the parents.

15. A geneticist notes that crossing a round shaped radish with a long shaped radish produces oval shape radishes. If oval radishes are crossed with oval radishes, the following phenotypes are noted: 100 long, 200 oval, and 100 round radishes. For the cross between a pure-breeding round and a pure-breeding long radish, use symbols to show the F_1 and F_2 generations.

16. Sickle cell anemia displays incomplete dominance inheritance. In the heterozygous condition, red blood cells are mildly misshapen but in the homozygous condition, they are seriously deformed and result in considerable pain and tissue and organ damage. If two heterozygous individuals planned to have children, what information would you have for them concerning the possibilities of them having normal children?

17. Palomino horses are known to be caused by the interaction of two different genes. The allele C^r in the homozygous condition produces a chestnut, or reddish color, horse. The allele C^m produces a very pale cream color, called cremello, in the homozygous condition. The palomino color is caused by the interaction of both the chestnut and cremello alleles. Indicate the expected ratios in the F_1 generation from mating a palomino with a cremello.

18. The flower color alleles in the red and white 4 o'clock flower are incompletely dominant. If we mate a homozygous red flower (F^RF^R) with a homozygous white flower (F^WF^W), all of the F_1 flowers are pink. If two pink flowered plants are crossed,
a) What are the chances of having pink offspring?
b) What are the chances of having red offspring?
c) What are the chances of having white offspring?
d) What is the genotypic ratio in the F_2?
e) What is the phenotypic ratio in the F_2?

19. In a disputed paternity case, Shaniqua has blood type B and has a child with type O. She claimed that it had been fathered by Raul, who has type A. What can be proved from these facts?

20. Indicate the blood types possible from the mating of a male who is blood type O with a female of blood type AB. Could a female with blood type AB ever produce a child with blood type AB? Could she ever have a child with blood type O?

21. Multiple alleles control the coat color of rabbits. A gray color is produced by the dominant allele C. The C^{ch} allele produces a silver-gray color when present in the homozygous condition, $C^{ch}C^{ch}$, called chinchilla. When C^{ch} is present with a recessive gene, a light silver-gray color is produced. The allele C^h is recessive to both the full color allele and the chinchilla allele. The C^h allele produces a white color with black extremities. This coloration pattern is called Himalayan. An allele C^a is recessive to all the other alleles. The C^a allele results in a lack of pigment, called albino. The dominance hierarchy is $C > C^{ch} > C^h > C^a$. The table below provides the possible genotypes and phenotypes for coat color in rabbits. Notice that four genotypes are possible for full color but only one for albino.

Phenotypes	Genotypes
Full color	CC, CC^{ch}, CC^h, CC^a
Chinchilla	$C^{ch}C^{ch}$
Light gray	$C^{ch}C^h$, $C^{ch}C^a$
Himalaya	C^hC^h, C^hC^a
Albino	C^aC^a

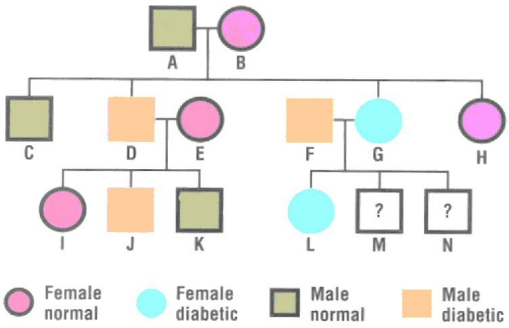
a) Indicate the genotypes and phenotypes of the F_1 generation from the mating of a heterozygous Himalayan coat rabbit with an albino coat rabbit.

b) The mating of a full color rabbit with a light gray rabbit produces two full color offspring, one light gray offspring, and one albino offspring. Indicate the genotypes of the parents.
c) A chinchilla color rabbit is mated with a light gray rabbit. The breeder knows that the light grey rabbit had an albino mother. Indicate the genotypes and phenotypes of the F_1 generation from this mating.
d) A test cross is performed with a light gray rabbit, and the following offspring are noted: five Himalayan color rabbits and five light gray rabbits. Indicate the genotype of the light-gray rabbit.

22. Flower color in certain plants displays epistasis. P= purple p= white, C= curved petals c= straight petals. A homozygous recessive petal shape prevents purple color. If parent plants are Ppcc x PPCc, what is the genotypic and phenotypic ratios of the offspring?

23 In mice, the gene C causes pigment to be produced, while the recessive gene c makes it impossible to produce pigment. Individuals without pigment are albino. Another gene, B, located on a different chromosome, causes a chemical reaction with the pigment and produces a black coat color. The recessive gene, b, causes an incomplete breakdown of the pigment, and a tan, or light-brown, color is produced. The genes that produce black or tan coat color rely on the gene C, which produces pigment, but are independent of it. Indicate the phenotypes of the parents and provide the genotypic and phenotypic ratios of the F_1 generation from the following crosses:
a) CCBB x Ccbb (b) ccBB x CcBb (c) CcBb x ccbb (d) CcBb x CcBb

24. Use the phenotype chart (pedigree) at the right to answer the following questions.
a) How many children do the parents A and B have?
b) Indicate the genotypes of the parents.
c) Give the genotypes of M and N.



25. For the family outlined below, draw a pedigree and give the genotype of each individual.
a) Generation I : A male with blood type O marries a female with blood type A.
b) Generation II : They have 4 children. The first born is a male with A type blood, the second born is a girl with O type blood, and the last two children were identical twin boys.
c) Generation III : The last boy married a woman with type B blood. They had two girls, one with AB blood type and one with B blood type.