15. A normal woman whose father was a hemophiliac marries a normal man. What are the chances of hemophilia occurring in their children?

16. Another woman with no history of hemophilia in her family marries a normal man whose father was a hemophiliac. What are the chances of hemophilia occurring in their children?

17. Color-blindness (c) is a sex-linked recessive trait, while normal color vision (C) is dominant.

A. If two normal-visioned parents have a color-blind son, what are the parents' genotypes?
B. What are the chances that their daughter will be color-blind?

In cats, yellow is due to gene B, and black to its allele b. These genes are sex-linked. The heterozygous condition results in tortoiseshell. What kinds of offspring (sex and color) are expected from a cross: black male x tortoise-shell female?

19. In fruit flies, normal long wings are dominant (Y) and vestigial (shortened) wings are recessive (y). These genes are autosomal. The sex-linked gene controlling red eye color (W) is dominant to white eyes (w). A male with red eyes and normal wings mates a white-eyed vestigial-winged female. Give the expected ratio of phenotypes in the F₂ generation.

Gene interactions

20. In poultry, there are two independently assorting gene loci, each with two alleles that affect the shape of a chicken's comb. One locus has a dominant allele (R) for rose comb while its recessive allele (r) produces single comb. The other locus has a dominant gene (P) for pea comb while its recessive allele (p) also produces single combs. When the two dominant genes occur together (R-P-), a walnut comb is produced. So, R-P- = walnut, R-pp = rose, rPp = pea, and rпп = single. Give the expected phenotypic ratios of offspring from the following matings:

A. RRPP x rпп
B. RрPp x rпп
C. Rпп x rпп
D. RрPP x RрPp
E. rрPp x RрPP

21. In humans, deafness can be the result of a recessive allele affecting the middle ear (dd = deaf), or another recessive allele (ee = deaf) that affects the inner ear. Suppose two deaf parents have a child that can hear. Give the genotypes of all three individuals.

22. If two normal people, heterozygous at both loci (DdEe) for deafness marry, what are the chances that their first child would be normal hearing? What is the chance of deafness in this child?

Multiple alleles

23. Mallard ducks show a multiple allele pattern of inheritance in which M₈ produces "restricted mallard" coloring and is dominant over M for mallard coloring, and both of these alleles are dominant over m for "dusky mallard" coloring. Give the phenotypic ratios expected among offspring from the following crosses:

A. M₈M x M₈m
B. M₈M x Mm
C. M₈m x M₈m

Multiple genes

24. If there are two pairs of genes involved in producing skin color in black x white crosses, and if the five phenotypic classes are black, dark, medium (mulatto), light, and white, give the expected F₂ results of a white x black mating.
ANSWERS TO GENETICS PROBLEMS

1. Purple is dominant.
2. Genotypic ratio: 1 BB: 2 Bb: 1 bb
   Phenotypic ratio: 3 white: 1 black
3. A cross with a black (bb) sheep.
4. White is dominant.
5. A. 3/4 yellow: 1/4 green
    B. 1/2 yellow: 1/2 green
    C. all green
6. Dd x Dd
7. 9 C-S- mule-foot, belted pigs
   3 C-ss mule-foot, solid pigs
   3 ccS- cloven-foot, belted pigs
   1 ccSS cloven-foot, solid pig
8. There are 3 cloven-foot, belted pigs, but only one is homozygous (ccSS); the other two are heterozygous (ccSs).
9. 9 F-T- flat and toothed
    3 F-ts flat and toothless
    3 ftT- fuzzy and toothed
    1 ftt fuzzy and toothless
10. Black spotted male (BBSS) x brown solid female (bbss).
11. BbSS male x bbss female.
12. |
    | RATIO | GENOTYPE | PHENOTYPE |
    |-------|----------|-----------|
    | 3 | P-RR | polled red |
    | 6 | P-Rr | polled roan |
    | 3 | P-rr | polled white |
    | 1 | ppRR | horned red |
    | 2 | ppRr | horned roan |
    | 1 | pprr | horned white |
13. A. Incomplete dominance with cream being heterozygous.
    B. 1 yellow: 2 cream: 1 white.
14. F1: Rs (pink)
    F2: 1/4 rr (red): 2/4 Rs (pink): 1/4 Rr (white).
15. 1/2 of the sons will inherit the defective gene from mom and get Y from dad. 1/2 of the daughters will also inherit the defective gene from mom but they will be heterozygous since they also inherit a normal gene from dad.
16. None is expected to have hemophilia or inherit the gene.
17. A. Cc (normal carrier woman) x Cy (normal man).
    B. W
    C. No chance; she inherits a normal C gene from dad as well as either C or c a gene from mom.
18. Black female, tortoiseshell female, black male, yellow male.
19. F2 for both sexes:
    3/8 red long
    3/8 white long
    1/8 red vestigial
    1/8 white vestigial
20. A. all walnut
    B. 1/4 walnut: 1/4 rose: 1/4 pea: 1/4 single
    C. 1/4 walnut: 1/4 rose: 1/4 pea: 1/4 single
    D. 3/4 walnut: 1/4 pea
    E. 1/2 walnut: 1/2 pea
24. F2: 25. A. black
    1/16 white
    4/16 light
    6/16 medium
    4/16 dark
    1/16 black
    B. black
    C. medium
    G. medium
    H. light

23. A. 3/4 restricted mallard:
    1/4 mallard
B. 1/2 restricted mallard:
    1/2 mallard
C. 1/2 mallard: 1/2 dusky mallard.