Chapter 17 Review Answers

Student Textbook pages 620–621

Answers to Understanding Concepts Questions

1. Pea plants were an excellent choice of organism because the plants are true-breeding, and self-pollinating, so Mendel could control the breeding. Each of the seven characteristics Mendel tested occurs in two distinct forms, dominant and recessive. There are no intermediates or blending, as would occur if their genes showed incomplete dominance or co-dominance.

2. Mendel's law of segregation states that all individuals have two copies (alleles) of each factor (gene). These copies (alleles) separate randomly during gamete formation, and each gamete receives one copy of every factor (gene).

3. (a) Drooping eyelid genotypes are *DD* and *Dd*.

(b)

	♂ *D*	*d*
♀ *d*	*Dd*	*dd*
d	*Dd*	*dd*

Genotype ratio = 1 Dd:1dd

Phenotype ratio = 1 drooping eyelids:1 non-drooping eyelids

(c) The woman is heterozygous.

4. The probability of one child being albino is still 0.25, regardless of whether previous children are albino. An example of this reasoning would be that the probability of a coin toss is 0.5 "heads" and 0.5 "tails", regardless of whether the coin is tossed ten times and comes up ten "heads". The probability of the eleventh toss is still 0.5 "heads" and 0.5 "tails". All things being equal, the probability of a previous event does not affect the probability of future events.

5. (a) The genotypes of the F_1 generation are all *Pp*. This is the only genotype that would provide three phenotypes in the F_1 generation.

(b) Punnett square of the F_2 is

	P	*p*
P	*PP*	*Pp*
p	*Pp*	*pp*

Genotype ratio = 1 pp:2Pp:1pp

Phenotype ratio = 1 purple:2 lavender:1 white

(c) This cross reveals incomplete dominance
Neiter purple nor white are dominant; they show a blending of their characteristics in the lavender phenotype.

6. A test cross is used to determine if a dominant individual is homozygous or heterozygous when the genotype is unknown. The individual of unknown genotype is crossed with a recessive individual, and if any recessives show in the offspring then the parent is heterozygous. If all offspring show the dominant trait, then it is presumed that the parent is homozygous dominant.

7. Mendel's law of independent assortment requires revision due to the process of crossing over, and the formation of offspring that have different combinations of traits compared to the parents. Linked genes do not assort independently.

8. (a) First grey male mouse—*GG,* albino female—*gg*, second grey male—*Gg*

(b) F_1 male *Gg* x female *Gg* would result in expected phenotypes in F_2 of 3 grey: 1 albino.

9. Blood types among the children could be types A, B, and AB. The man would be heterozygous type B, if any child were blood type A.

10. Possible genotypes of the father are I^AI^B, I^AI^O, and I^BI^O.

11. In females that are heterozygous for an observable sex-linked trait, such as a fur colour in a calico cat, each cell will have one X chromosome that is inactive in the form of a Barr body. The choice of which X chromosome becomes inactive is random. The calico cat has patches of orange and black fur because it has the allele for orange fur colour on one X chromosome, and the allele for black fur colour on the other X chromosome.

12. Only the stallions have the Y sex chromosome. The female offspring have XX sex chromosomes and therefore cannot pass a Y chromosome to their sons.

13. The P generation seeds are round (*R*) yellow (*Y*), and wrinkled (*r*) green (*y*). The F_1 generation seeds are all round and yellow. The F_2 generation seeds are round yellow, round green, wrinkled yellow, and wrinkled green indicating that the alleles for the two characteristics, seed shape and seed colour, segregate independently. That is,

the F_1 generation will produce four different gametes *RY*, *Ry*, *rY*, and *ry* if the chromosomes segregate independently during gamete formation in meiosis. The principle is independent assortment.

Answers to Applying Concepts Questions

14. No, you could not establish true-breeding platinum foxes, as the genotype for the form is heterozygous. A cross between *Pp* and *Pp* (platinum-coloured fur) parents will produce 0.25 *PP* (lethal), 0.5 *Pp* (platinum-coloured fur), and 0.25 *pp* (silver fur colour).

15. (a) Rudy is X^CY and Sinead is X^CX^c; therefore the girl will have the probabilities 0.5 X^CX^c normal colour vision (but a carrier for the colour blindness allele), and 0.5 X^CX^C normal colour vision. The chance of having a colour blind girl is 0.

(b) The probability of a boy with normal vision is 0.5 X^CY.

16. (a) The gene for wing shape is Y-linked. As the X chromosome is inherited from the female parent, some of the males would have normal wings if the gene for wing shape were X-linked.

(b) Cross F_1 females from the previous cross (normal-winged females and the stunted-winged male) with normal-winged males. If the gene is X-linked, then F_1 heterozygous females crossed with a normal-winged male will produce 0.5 of the F_2 males with stunted wings.

17. (a) If Mendel had selected traits that were linked, he would have noticed different phenotypic ratios from those described. Instead of the dihybrid 9:3:3:1 ratio, he would have ratios typical of evidence of recombination due to crossing over, such as 0.42:0.41:0.09:0.8. He would have combinations of traits not present in the parents.

(b) Students' answers will depend on their level of understanding of Mendellian genetics and crossing over. One possible hypothesis that Mendel might have tested is if the traits are carried on the same chromosome, then a cross between two plants—one plant pure breeding for both dominant traits, and the second plant pure breeding for both recessive traits, should produce offspring that only display the dominant phenotype.

(c) Mendel could have crossed the two parental plants, e.g., maternal pure breeding dominant for both traits, and paternal pure breeding recessive for both traits. He may have observed recombinants in the F_1 phenotypes, indicating that there was crossing over of the maternal and paternal genes.

18. Polled is dominant because two heterozygous polled cattle could produce horned cattle. If polled were a recessive trait, then crosses between two recessive individuals would only produce offspring with the recessive phenotype. A dominant phenotype could not be produced because there would be no dominant allele.

19. (a) The farmer could selectively breed tall corn plants and harvest the seeds from the offspring and then repeat the process again and again.

(b) The farmer's work would be easiest if the height of corn plants were determined by multiple alleles or co-dominance because then he/she could select only the tall plants to breed, instead of working with varying heights produced by polygenic inheritance.

(c) The farmer would test various parent crosses e.g. tall plants with tall plants, medium height with medium height, and short with short to see if the offspring of particular crosses of heights show evidence of the disease.

(d) The farmer would avoid selecting any plant for breeding that showed the disease and then select only the tall plants for breeding from the disease-free offspring.

20. If the genes are linked but very close together, then crossing over is unlikely to produce different combinations in the gametes. Alternatively, if the genes are so far apart from each other that crossovers occur often, then the frequency of recombination between these genes could have a maximum value of 50 percent, which would be indistinguishable from genes on different chromosomes.

21. OI displays autosomal recessive inheritance. I1, II1-II5: are heterozygous; I2, III2, and III3 are homozygous recessive; III1 and III4 are heterozygous or homozygous dominant, it is uncertain which. I2, III2, and III3 have OI. All other individuals have normal phenotypes.

Answers to Making Connections Questions

22. (a) What is the probability that we could have a child with cystic fibrosis (CF)? If we were to have a child, would the treatment be any different from Brian's sister? Are there different degrees of severity within relatives that have CF? Is there the likelihood of a cure for CF being developed?

(b) Brian's sister has inherited the disease from her parents. The parents are carriers for the disease but do not have the symptoms of the disease. In other words, they are heterozygous for CF. The probability that Brian is also heterozygous for CF is 0.5. There are many genetic variations of the CF gene, and, as a result, there are varying degrees of severity. At present the symptoms are treatable; however, there is no cure.

(c) Does Sarah have any history of CF in her family? If not, then it is unlikely that she is a carrier like Brian's parents. Assuming this to be the case, then there is a 0.5 probability that their children would also be carriers, but none would have the disease.

23. The most successful presentations will stay on topic and provide arguments that clearly address the question provided. Accept any reasonable and well-presented points of view that address both sides of the issue.

24. This information can help children understand that being carriers of a genetic disorder means that the disorder could be present in their children, if their spouse has the same gene. For minor disorders, such as colour blindness, this may seem trivial, but helping children understand how traits are inherited provides them with the knowledge to make informed decisions.

25. Inbreeding (breeding animals that are closely related, such as siblings or cousins), results in a greater probability that undesirable traits will be exhibited as these individuals often carry the same recessive alleles. There is less chance of the genetic disorder appearing if very distantly related breeding stock is selected from other breeders.