Section 17.1 Review Answers

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1. Two coins represent the parents and the heads and tails represent the two alleles. A toss of two coins could result in the following four “genotypes”: two “heads,” a “head” on the first coin and “tail” on the second, a “tail” on the first coin and a “head” on the second, or two “tails.” Assuming “heads” to be dominant, then these four “genotypes” would represent the “phenotypes” 3 dominant (“heads”) and 1 recessive (“tails”).
2. Mendel’s experiments were unusual for biology experiments in the 1800s because no one expected a monk in a monastery to be growing thousands of pea plants to study inheritance. He was not a “recognized” scientist at the time he published his work. He chose to study seven characteristics of pea plants that, as it turns out, are located on the 7 pairs of chromosomes (1 gene per chromosome). Chromosomes and gene linkage were unknown at the time. Mendel must have done a great deal of prior research to know which seven characteristics to study.
3. Selective breeding refers to choosing which plants or animals to breed in hopes of obtaining the desired characteristics. True breeding refers to breeding only the plants or animals that produce the trait that is wanted and are known to produce that trait generation after generation.
4. The law of segregation refers to the separation of the genes’ alleles on homologous chromosomes during meiosis and the formation of gametes.The alleles segregate randomly and each gamete receives one allele of each gene.

5. By crossing true breeding peas with green pods with true breeding peas with yellow pods and observing the pod colour of the F_1 generation, it is possible to determine which pod colour is dominant. Because the pea plants are true breeding, their genotypes must be *GG* and *gg*. Thus, all the F_1 plants will be *Gg* and exhibit the dominant phenotype. If all the F_1 plants have green pods, green pods are dominant and yellow pods are recessive. The reverse is true if all the F_1 plants have yellow pods.

6. **(a)** The genotype for the F_1 generation is *IiAa*. The phenotype is inflated pods with axial flowers.

   (b) F_2 genotypes and phenotypes are determined by a 4x4 Punnett square by placing the F_1 gametes *IA, Ia, iA,* and *ia* across the top of the square, and these same gametes on the left side of the square.

   The genotypes and ratios of the F_2 are: 4/16 *IiAa*, 2/16 *IiAA*, 2/16 *Iiaa*, 2/16 *IIAa*, 2/16 *iiAa*, 1/16 *IIAA*, 1/16 *IIaa*, 1/16 *iiAA*, and 1/16 *iiaa*. The phenotypes and ratios of the F_2 are: 9/16 inflated pod shape and axial flower position, 3/16 inflated pod shape and terminal flower position, 3/16 constricted pod shape and axial flower position, and 1/16 constricted pod shape and terminal flower position.

   (c) The law of independent assortment states that two alleles for one gene segregate independently of the alleles for other genes during meiosis. The experimental data and ratios in part B support this law because they show that the alleles I and i are sorted independently from alleles A and a, as can be seen in the nine different possible genotypes. .

7. Fruit flies—predicted phenotypes for wing length and body colour for 256 offspring:

   (a) Long, gray 9/16 of 256 = 144

   (b) Long, black 3/16 of 256 = 48

   (c) Short, gray 3/16 of 256 = 48

   (d) Short, black 1/16 of 256 = 16

8. **(Note: Question should refer to problem 7, not problem 5.)**

   The fruit fly genotype *LlGg*, when crossed with a llgg genotype, would produce the 1:1:1:1 ratio of long, grey: long, black: short, grey: short, black. The probability of selecting a fruit fly offspring to produce this ratio is as follows: The probability of offspring being long-winged and grey-bodied is 9/16 and the probability of offspring being genotype *LlGg* is 4/16; therefore, the probability of the long-winged and grey-bodied offspring being selected to produce this ratio is 4/9.

9. In problem 8, the genotypes of the parental generation would be *LlGg* × *LlGg*. The results of 139:49:53:15 are close to the expected 148:48:48:16 or the 9:3:3:1 that would be consistent with a heterozygous dihybrid cross of two LlGg fruit flies.

10. Incompletely dominant alleles do not show one trait or the other, but show a "blending" of these characteristics. For example, the flowers of white and red four o'clock plants produce heterozygous pink flowers with the pigment produced by each incompletely dominant allele. Co-dominant alleles are each expressed without "blending" of the trait. For example, roan coat colour in cattle is produced by crossing a cow with a red coat and a bull with a white coat. The roan coat contains intermingled red and white hairs on the coat, rather than a mixing of the red and white pigments in individual hairs. Both alleles are co-dominant and expressed individually in the hair colour. Conversely, if alleles are dominant and recessive, in a heterozygous individual, only the dominant trait will be apparent.

11. **(a)** The black and white alleles are co-dominant because both black and white feathers are produced in some of the offspring.

    (b) No, the ratios of characteristics among the offspring do not follow the pattern you would expect because seven offspring is too small a sample to produce the expected ratio of 1 black:2 speckled:1white. To draw conclusions about the inheritance of this trait, one would need to produce a larger number of offspring.

12. During gamete formation, homologous chromosomes segregate, as do alleles. Also during meiosis, the movement of each pair of homologous chromosomes is independent of all the other pairs; alleles, similarly, assort independently. This discovery by Walter Sutton led to the chromosome theory of inheritance.