Section Summary

Working with garden pea plants, Mendel found that crosses between parents that differed by one trait produced F_1 offspring that all expressed the traits of one parent. Observable traits are referred to as dominant, and non-expressed traits are described as recessive. When the offspring in Mendel's experiment were self-crossed, the F_2 offspring exhibited the dominant trait or the recessive trait in a 3:1 ratio, confirming that the recessive trait had been transmitted faithfully from the original P plant. Reciprocal crosses generated identical F_1 and F_2 offspring ratios. By examining sample sizes, Mendel showed that his crosses behaved reproducibly according to the laws of probability, and that the traits were inherited as independent events.

Mendel hypothesized that genes are inherited as pairs of alleles that behave in a dominant and recessive pattern. Alleles segregate into gametes such that each gamete is equally likely to receive either one of the two alleles present in a diploid individual. Also, genes are assorted into gametes independently of one another. That is, in general, alleles are not more likely to segregate into a gamete with a particular allele of another gene. A dihybrid cross demonstrates independent assortment when the genes in question are on different chromosomes or distant from each other on the same chromosome.

Exercises

1. The observable traits expressed by an organism are described as its _____.
    a. phenotype
    b. genotype
    c. alleles
    d. zygote
2. A recessive trait will only be observed in individuals that are _____ for that trait.
    a. heterozygous
    b. homozygous recessive
    c. homozygous dominant
    d. diploid
3. What are the types of gametes that can be produced by an individual with the genotype *AaBb*?
    a. *Aa*, *Bb*
    b. *AA*, *aa*, *BB*, *bb*
    c. *AB*, *Ab*, *aB*, *ab*
    d. *AB*, *ab*
4. On a pedigree, how would an affected male be notated?
    a. Shaded / solid circle
    b. unshaded circle
    c. shaded/ solid square
    d. unshaded square
5. Use a Punnett square to predict the offspring in a cross between a dwarf pea plant (homozygous recessive) and a tall pea plant (heterozygous). What is the phenotypic ratio of the offspring?
6. Use a Punnett square to predict the offspring in a cross between a tall pea plant (heterozygous) and a tall pea plant (heterozygous). What is the genotypic ratio of the offspring?

Answers

1. (a)
2. (2)
3. (3)
4. (3)
5. The Punnett square would be 2 × 2 and will have *t* and *t* along the top and *T* and *t* along the left side. Clockwise from the top left, the genotypes listed within the boxes will be *Tt*, *Tt*, *tt*, and *tt*. The phenotypic ratio will be 2 tall:2 dwarf.
6. The Punnett square will be 2 × 2 and will have *T* and *t* along the top and *T* and *t* along the left side. Clockwise from the top left, the genotypes listed within the boxes will be *TT*, *Tt*, *Tt*, and *tt*. The genotypic ratio will be 1*TT*:2*Tt*:1*tt*.

Glossary

allele: one of two or more variants of a gene that determines a particular trait for a characteristic

dihybrid: the result of a cross between two true-breeding parents that express different traits for two characteristics

dominant: describes a trait that masks the expression of another trait when both versions of the gene are present in an individual

gene: the basic unit of heredity

genotype: the underlying genetic makeup, consisting of both physically visible and non-expressed alleles, of an organism

heterozygous: having two different alleles for a given gene on the homologous chromosomes

homozygous: having two identical alleles for a given gene on the homologous chromosomes

law of dominance: in a heterozygote, one trait will conceal the presence of another trait for the same characteristic

law of independent assortment: genes do not influence each other concerning sorting of alleles into gametes; every possible combination of alleles is equally likely to occur

law of segregation: paired unit factors (i.e., genes) segregate equally into gametes such that offspring have an equal likelihood of inheriting any combination of factors

monohybrid: the result of a cross between two true-breeding parents that express different traits for only one characteristic

phenotype: the observable traits expressed by an organism

Punnett square: a visual representation of a cross between two individuals in which the gametes of each individual are denoted along the top and side of a grid, respectively, and the possible zygotic genotypes are recombined at each box in the grid

pedigree: to chart used to study inheritance patterns of genetic characteristics

recessive: describes a trait whose expression is masked by another trait when the alleles for both traits are present in an individual