

Chapter 11 - Lecture Outline – Observing Patterns of Inherited Traits

Impacts, Issues: In Pursuit of a Better Rose

- A. Roses have been around for at least 40 million years; rose breeders practice artificial selection by selecting for desired traits like petal color or floral scent, then waiting for the growth of the new plants to see if this trait shows up in the next generation(s).
- B. Today, *marker-assisted selection* uses radioisotopes by making a DNA probe that will test offspring from a cross for the presence of the desired trait in much less time and with greater efficiency.

11.2 Mendel, Pea Plants, and Inheritance Patterns

A. Mendel's Experimental Approach

1. Mendel used the _____ in his experiments.
 - a. This plant can fertilize itself; _____ varieties were available to Mendel.
 - b. Peas can also be _____ by human manipulation of the pollen.
2. Mendel cross-fertilized _____ garden pea plants that had clearly contrasting traits (example: white vs. purple flowers).

B. Terms Used in Modern Genetics

1. _____ are units of information about specific traits, each located at a particular *locus* on a chromosome.
2. Diploid cells have two genes (a gene pair) for each trait—each on a *homologous chromosome*.
3. _____ alters a gene's molecular structure; *alleles* are various molecular forms of a gene for the same trait.
4. _____ occurs when offspring inherit identical alleles, generation after generation; non-identical alleles produce *hybrid offspring*.
5. When both alleles are the same, the condition is called the _____ condition; if the alleles differ, then it is the *heterozygous* condition.
6. When heterozygous, one allele is _____ (*A*), and the other is *recessive* (*a*).

7. Homozygous dominant = _____; homozygous recessive = _____; and heterozygous = Aa
8. _____ is the particular alleles an individual carries, and *phenotype* is how the genes are expressed physically (what you observe).
9. P = true-breeding parental generation; F₁ = first-generation offspring; and F₂ = second-generation offspring of self-fertilized or intercrossed F₁ individuals.

11.2 Mendel's Theory of Segregation

A. Monohybrid Experiment Predictions

1. Mendel suspected that every plant inherits two "units" (_____) of information for a trait, one from each parent on pairs of homologous chromosomes.
2. Mendel's first experiments were _____ crosses.
 - a. Monohybrid crosses have two parents that are _____ for contrasting forms of a trait (white vs. purple flowers).
 - b. One form of the trait (_____) disappears in the first generation offspring (F₁), only to show up in the second generation (F₂).
 - c. We now know that all members of the F₁ offspring are _____ (Aa) because one parent could produce only an A gamete and the other could produce only an a gamete.
3. In the F₂ generation, the _____ flowers reappeared.
 - a. The numerical ratios of crosses suggested that genes do not _____.
 - b. For example, the F₂ offspring showed a _____ phenotypic ratio of purple to white.
 - c. Mendel assumed that each sperm has an _____ probability of fertilizing an egg. This can be seen most easily by using the Punnett square.
 - d. Thus, each new plant has _____ chances in four of having at least one dominant allele.

B. Testcrosses

1. Mendel's theory of segregation states that _____ organisms inherit pairs of genes on pairs of homologous chromosomes. Each gene segregates from the other during meiosis such that each gamete will receive only one gene per trait.

11.3 Mendel's Theory of Independent Assortment

- A. Dihybrids are the offspring of parents that breed true for different versions to two traits.
1. Mendel also performed experiments involving two traits—a dihybrid cross.
 - a. Mendel correctly predicted that all F₁ plants would show both of the dominant alleles (example: all purple flowers and all tall plants).
 - b. Mendel wondered if the genes for flower color and plant height would travel together when two F₁ plants were crossed.
 2. The F₂ results showed 9/16 were tall and purple-flowered and 1/16 were dwarf and white-flowered—as were the original parents; however, there were 3/16 each of two new combinations: dwarf purple-flowered and tall white-flowered.
- B. Mendel's theory of independent assortment states that as meiosis ends, genes on pairs of homologous chromosomes have been sorted out for distribution into one gamete or another, independently of gene pairs of other chromosomes.

11.4 More Patterns Than Mendel Thought

A. Codominance in ABO Blood Types

1. In codominance, both alleles are expressed in _____.
2. Blood type is determined by markers produced by three genes—a multiple allele system.
 - a. I^A and I^B are each dominant to _____, but are codominant to each other.
 - b. Therefore, some persons can express both genes and have AB blood.

B. Incomplete Dominance

1. In _____, a dominant allele cannot completely mask the expression of another.
2. For example, a true-breeding red-flowered snapdragon crossed with a white-flowered snapdragon will produce _____ flowers because there is not enough red pigment (produced by the dominant allele) to completely mask the effects of the white allele.

C. Epistasis

1. One gene pair can influence other gene pairs, with their combined activities producing some effect on phenotype.
2. In Labrador retrievers, one gene pair codes for the *quantity* of melanin produced while another codes for melanin *deposition*.
3. Still another gene locus determines whether melanin will be produced at all—lack of any produces an albino (recessive).
4. Comb shape in chickens is of at least four types, depending on the interactions of two gene pairs (R and P).

11.6 Genes and the Environment

- A. The environment contributes to variations in gene expression among individuals in a population.
1. Fur on the extremities of _____ will be darker, because the enzyme for melanin production will operate at cooler temperatures but is sensitive to heat on the rest of the body.
 2. Cuttings from yarrow plant clones grew differently at three different altitudes; the color of the floral clusters on *Hydrangea* plants will vary depending on the acidity of the soil.
- B. Some people tolerate stress better than others perhaps due to differences in the gene for a serotonin transporting protein.

11.7 Complex Variations in Traits

- A. Regarding the Unexpected Phenotype
1. Tracking even a single gene through several generations may produce results that are different than expected.
 2. Camptodactyly (immobile, bent fingers) can express itself on one hand only, both hands, or neither due to the possibility that a gene product is missing in one of the several steps along the metabolic pathway.
- B. Continuous Variation in Populations
1. A given phenotype can vary, by different degrees, from one individual to the next in a population as a result of interactions with other genes and environmental influences.
 - a. This feature is known as polygenic inheritance, where many genes affect one trait.
 - b. In humans, eye color and height are examples.
 2. Most traits are not qualitative but show continuous variation and are transmitted by quantitative inheritance.