Chapter 14 summary

BIO

- ♣ During the 1800s, the "**blending**" hypothesis is the idea that genetic material from the two parents blends together (like blue and yellow paint blend to make green)
- ♣ The "**particulate**" hypothesis is the idea that parents pass on discrete heritable units (genes)
- ♣ Mendel documented a particulate mechanism through his experiments with garden peas
- ♣ Mendel discovered the basic principles of heredity by **breeding garden peas** in carefully planned experiments
- ♣ Mendel chose to track only those characters varied in an either-or manner
- ♣ He also used varieties that were true breeding (plants that produce offspring of the same variety when they self-pollinate)
- ♣ A true breeding is a kind of breeding wherein the parents would produce offspring that would carry the same phenotype. This means that the parents are **homozygous**(TT) for every trait.
- ♣ In a typical experiment, Mendel mated two contrasting, true-breeding varieties(TT, tt), a process called **hybridization**
- ♣ The true-breeding parents are the **P generation**
- ♣ The hybrid offspring of the P generation are called the **F_1 generation**
- ♣ When F_1 individuals self-pollinate, the **F_2 generation** is produced

➢ ***Mendel's laws:***

I. Mendel's first law: The Law of Segregation

• When Mendel crossed contrasting, true breeding white and purple flowered pea plants, all of the F_1 hybrids were **purple**

• When Mendel crossed the F_1 hybrids, many of the F_2 plants had **purple** flowers, but some had **white**

• Mendel discovered a **ratio** of about three to one **(3:1),** purple to white flowers, in the F_2 generation

• Mendel called the purple flower color a **dominant trait** and the white flower color a **recessive trait**

• Mendel observed the same pattern of inheritance in six other pea plant characters, each represented by two traits

• What Mendel called a "heritable factor" is what we now call a **"gene"**

Character	Dominate trait	Recessive trait
Flower color	purple	White
Flower position	axial	Terminal
Seed color	yellow	green
Seed shape	round	Wrinkled
Pod shape	inflated	constricted
Pod color	green	Yellow
Stem length	tall	dwarf

• **Law of segregation**: states that the two alleles for a heritable character separate (segregate) during gamete formation and end up in different gametes

• Thus, an egg or a sperm gets only one of the two alleles that are present in the somatic cells of an organism

• Mendel's segregation model accounts for the 3:1 ratio he observed in the F_2 generation of his numerous crosses

• The possible combinations of sperm and egg can be shown using a **Punnett square**, a diagram for predicting the results of a genetic cross between individuals of known genetic makeup

• A **capital** letter represents a **dominant** allele, and a lowercase letter represents a recessive allele

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➢ ***Useful Genetic Vocabulary:***

- An organism with two identical alleles for a character is said to be **homozygous** for the gene controlling that character
- An organism that has two different alleles for a gene is said to be **heterozygous** for the gene controlling that character
- An organism's physical appearance: is called its **phenotype**
- An organism's genetic makeup is called its **genotype**.
- In the example of flower color in pea plants, PP and Pp plants have the same phenotype (purple) but different genotypes
- **The Testcross:** Used to determine the genotype of an organism that shows the dominant phenotype.

* Such an individual must have one dominant allele, but the individual could be either homozygous dominant or heterozygous
* The answer is to carry out a testcross: breeding the mystery individual with a homozygous recessive individual
* If any offspring display the recessive phenotype, the mystery parent must be heterozygous

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II. Mendel's second law: The Law of Independent Assortment

• Mendel derived the law of segregation by following a single character

• The F_1 offspring produced in this cross were monohybrids, individuals that are heterozygous for one character

• A cross between such heterozygotes is called a monohybrid cross

• Mendel identified his second law of inheritance by following two characters at the same time

• Crossing two true-breeding parents differing in two characters produces dihybrids in the F_1 generation, heterozygous for both characters

• A dihybrid cross, a cross between F_1 dihybrids, can determine whether two characters are transmitted to offspring as a package or independently

• The law of independent assortment states that each pair of alleles segregates independently of each other pair of alleles during gamete formation

• Strictly speaking, this law applies only to genes on different, nonhomologous chromosomes

• Genes located near each other on the same chromosome tend to be inherited together

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➢ ***Inheritance patterns are often more complex than predicted by simple Mendelian genetics:***

♣ The relationship between genotype and phenotype is rarely as simple as in the pea plant characters Mendel studied

♣ Many heritable characters are not determined by only one gene with two alleles

♣ However, the basic principles of segregation and independent assortment apply even to more complex patterns of inheritance

♣ Inheritance of characters by a single gene may deviate from simple Mendelian patterns in the following situations:
– When alleles are not completely dominant or recessive
– When a gene has more than two alleles
– When a gene produces multiple phenotypes

♣ Degrees of Dominance:

- Complete dominance occurs when phenotypes of the heterozygote and dominant homozygote are identical
- In incomplete dominance, the phenotype of F_1 hybrids is somewhere between the phenotypes of the two parental varieties,Example: Snapdragon flower color
- In codominance, two dominant alleles affect the phenotype in separate, distinguishable ways. Example: blood groups (A & B)

♣ Multiple Alleles:

- Most genes exist in populations in more than two allelic forms
- For example, the four phenotypes of the ABO blood group in humans are determined by three alleles for the enzyme (I) that attaches A or B carbohydrates to red blood cells: I^A , I^B , and i.
- The enzyme encoded by the I^A allele adds the A carbohydrate, whereas the enzyme encoded by the I^B allele adds the B carbohydrate; the enzyme encoded by the i allele adds neither