Unit 5: Mendelian Genetics
Content Outline: Mendel and Mendelian Genetics (5.1)

I.  Gregor Mendel (1850) - He is considered to be the "Father of Genetics".
    A.  He was a monk who worked with pea plants. (This is because he was the cook too.)

II. **Character**
    A.  An *inheritable physical feature*.  (This is a *characteristic* such as eye color or hair color.)

III. **Trait**
    A.  This requires inheriting *two* alleles; one from *each parent*.
    B.  This is a *variation of a character*. (Such as *blue* colored eyes or *black* colored hair.)

IV. **Alleles**
    A.  This term refers to *different versions of a gene*. Remember a gene is a *distinct DNA sequence* that can make one protein or enzyme. (Brown, blue, green eye color. There are three different *versions* or *DNA sequences* of a single gene, but they <u>all</u> are making the eye *color*.)
    B.  Each trait *needs* two alleles. (One from each parent to be made or "expressed".)
    C.  **Dominant** alleles are given *capital letters*. (These are like books or recipe cards *with information* in them.) If a dominant allele is present, the trait it codes for is expressed. <span style="color:red">(Show some recipe cards)</span>
    D.  **Recessive** alleles are given *lower case letters*. (These are like books or recipe cards with *blank pages* – no information is on them on *how* to make the protein or enzyme. The "blueprint" is missing.) <span style="color:red">(Index cards)</span>
    E.  <span style="color:red">Students should understand the each paper card represents a DNA nucleotide sequence. One just has information for making a fully functioning protein or enzyme and the other sequence still makes "something" but it most likely will not function or function properly. This will help set up taking about albinism as must organisms are stark white like the blank index card. It also helps set up talking about the terms below. Students can *see* dominant overrides recessive and the effect. Recipe cards can be found in all grocery stores and are usually free.</span>

V.  **True "pure" breed**
    A.  These organisms only have one *type* of alleles for that trait. (BB or bb for example.)
    B.  A.K.A. **Homozygous alleles**.  ( "Homo" means "same")

VI. **Hybridization**
    A.  This is the process of "creating" an organism with two *different* types of alleles for that trait. (Such as Bb.)
        1.  Referred to as **Hybrid** or **Heterozygous alleles**. ("hybrid" and "hetero" mean "different")

VII. **Phenotype** ("pheno" means "physical")
    A.  This term refers to a *physical trait* that can be seen. (Blue eyes or Type A blood, would be examples.)

VIII. **Genotype** ("geno" means "genetic")
    A.  This term refers to an *organism's genetic (DNA) make-up* for a trait. (Such as BB, Bb, and bb.)
    B.  If the genotype of an organism is unknown, we can perform a **Testcross** to find it.
        1.  To perform this test, we <u>must</u> use a *homozygous recessive* to mate with our unknown.
            a.  This allows for no information to be "covered up" by a *known* dominant allele.

IX. Punnett Square
    A.  This is a chart showing the *possible* genotypic outcomes for a *mating cross* based on parent's genotypes.
    B.  **Monohybrid** – This chart displays *one* trait. (It has *4* squares.) ( $4^1 = 4$ squares)
    C.  **Dihybrid** – This chart displays *two* traits. (It has *16* squares.) ($4^2 = 16$ squares)
    D.  **Trihybrid** – This chart displays *three* traits. (It has *64* squares.) ($4^3 = 64$ squares)
    E.  <span style="color:red">Please help students see the math relationship. 4 possibilities  for each trait. Number of traits being considered is the exponent. Students should see math as the language of science.</span>

X.  Mendel's **Law of Segregation** (Segregate means "to separate")
    A.  This states that *alleles on homologous chromosomes* move *independently* of one another. They "walk" to opposite poles of the germ cell during Anaphase I. This separation is continued though Anaphase II when the sister chromatids are isolated into individual gametes.
    B.  This occurs at Anaphase I and II in Meiosis. It also occurs in Anaphase of Mitosis too.

XI. Mendel's **Law of Independent *Assortment*** (This law describes the behavior of pairs of homologous chromosomes during Metaphase I.)

A. Each pair of homologous chromosomes moves to the metaphase plate during Metaphase I independently of any other chromosome pair, and the *random placement* of the chromosome pair along the Metaphase plate.

B. A good way to show this is to use your two hands. Put them side by side like you are pushing something away; palms open and exposed to the students. Then show separation during Anaphase. Right hand going to right and left hand going left.(That is one possibility.) Then put your hands side by side again *but crossed* so that your right hand is on the left side of the mid-plane and your left hand on the right side. (This is another possible combination.) Then separate with the left going right and the right going left. Point out the Variation of the digits on your hands to tie back in to character, traits, and alleles.

XII. **Probability** "Chance"

A. This refers to the *likelihood of a certain outcome* actually happening. (What are the chances of…occurring?)

B. Probability ranges on a scale between 0 and 1.00. (From 0% to 100% essentially.) 0.5 is 50% and so on.

C. On a monohybrid Punnett square, each square *represents a 25% chance of outcome*.

D. *Add all boxes that have the same genotypes together to get the total probability.*

E. Please work students through various mating pairs and indicating the probability of expressing certain traits. These are usually test type questions on EOC or ACT style tests.