Genetics Notes Chapter 3

Intro

- If two genes are on two different chromosomes then these chromosome pairs act independently at meiosis and the alleles of the gene pairs are said to show **independent assortment**.

3.1

- The following symbolism is used for genotypes that include two genes:
- A/a; B/b for genes located on two separate chromosomes
- Ab/aB or AB/ab for genes located on the same chromosome.
- A double heterozygote (A/a;B/b or Ab/aB) is called a dihybrid and a cross between the two is a **dihybrid cross.**
- In a dihybrid cross of peas all the F1 generation were heterozygous and displayed the dominant phenotype for both characters.
- In a dihybrid cross of the F1 generation, the F2 generation displayed a ratio of 9:3:3:1
- **Mendel's Second Law (The Law of Independent Assortment)**-two different gene pairs on two different chromosomes pairs assort independently at meiosis.
- For example, the allele for a yellow pea is just as likely to assort into a gamete with an allele for a wrinkle pea or round pea. An allele for a green pea is also just as likely to assort into a gamete with an allele for a wrinkled or a round pea.

3.2

- Statistics can be used to predict phenotypic ratios in progeny.
- The **product rule** states that the probability of two independent events occurring at the same time is the product of their individual probabilities.
- The **sum rule** states that the probability of either of two mutually exclusive events happening is the sum of their probabilities.
- Example: Cross A/a; b/b; C/c; D/d; E/e x A/a; B/b; C/c; d/d; E/e to find probability of progeny with the genotype a/a; b/b; c/c; d/d; e/e
- First do a cross independently for each gene.
- Multiply the likelihood of recessive/recessive for each (using the multiplication rule) to find the probability of all the events occurring.
- Repeated selfing increases the number of homozygotes which then can be used as pure lines for research or other purposes.
- Generally there is a superiority of heterozygotes called **hybrid vigor**.
- However this can break up when this generation undergoes meiosis and the favorable allelic combinations may not remain.

3.3

- There is a chromosomal basis to independent assortment in that if one chromosome pair is 1' and 1'' and the other is 2' and 2'', 1' can be packaged with 2'or 2'' and vice-versa depending on which is pulled in the same direction as it during anaphase.

- It is normally difficult to see this occur since usually homologous chromosomes appear the same. However in a heteromorphic pair, the pair of chromosomes share only partial homology allowing for independent assortment to be seen.
- The process of new allele combinations is called **recombination**.
- Recombination provides variation which is the raw material for natural selection.
- A meiotic recombinant output is one with a genotype that differs from either of the parent cells.
- A recombinant frequency of 50 percent indicates that the genes are independently assorting and are most likely on different chromosomes.

3.4

- Although the focus up until this point has mostly been on the inheritance of a single gene that has two distinct alleles a large proportion of natural variation takes the form of continuous variation. These characters can take any value between two extremes ex. Height or weight
- These are metric or **quantitative characters**
- Many genes and alleles interact to produce this quantitative character. These interacting genes are called **polygenes** or **quantitative trait loci**.

3.5

- Mitochondria and chloroplasts have some of their own extranuclear DNA inherited independently from nuclear DNA.
- Even though they have some of their own genes they still rely on the nuclear genome for their complete function.
- This organelle DNA is circular and has a lot of copies in each organelle and many organelles in the cell.
- This DNA is concentrated in a sub-organelle nucleoid region but it not wrapped up in histones like nuclear DNA is.
- **Mitochondrial DNA (mtDNA)** and **Chloroplast DNA (cpDNA)**
- Organelle genes show **uniparental inheritance**, they inherit their genes from on parent exclusively
- In most cases the parent is the mother showing **maternal inheritance**.
- This is because female gametes (the egg) contributes the majority of the zygotes' cytoplasm and it is in this cytoplasm where the organelles reside.
- In some cases cells contain mixtures of mutant and normal organelles these are called **cytohets** or **heteroplasmons**. In these instances, the two different chloroplasts tend to segregate.
- This is called **cytoplasmic segregation**.
- Diseases passed from mother to children are often a sign of a mitochondrial DNA mutation.