Objectives for Unit Nine: Chapters 11 - 12
Genetics: (Double Period Test)

You should be able to:

1. Describe Mendel's Experiments.
   - Explain the advantages of using pea plants in the experiments.
   - Define and distinguish among true-breeding organisms, hybrids, the P generation, the F1 generation, and the F2 generation.
   - Summarize Mendel's conclusions.
2. Explain and apply Mendel's Laws of Inheritance based on his observation of pea plants.
3. Define and distinguish between the following pairs of terms:
   - genotype & phenotype
   - dominant allele & recessive allele
   - heterozygous & homozygous
   - monohybrid cross & dihybrid cross
   - Law of Segregation and Law of Independent Assortment
4. Explain how a testcross is performed to determine the genotype of an organism.
5. Describe the inheritance patterns of (be able to make & interpret Punnett squares) of each of the following: (You must be able to work genetics problems efficiently - PRACTICE!!)
   - Dominance (monohybrid & dihybrid)
   - Incomplete Dominance and Co-Dominance
   - Multiple Alleles
   - Sex-Linked Traits (X-linked traits)
   - Autosomally linked genes and calculate the recombination frequency & map distance
6. Explain how the inheritance pattern of blood type (The A, B,O system) is an example of an exception to Mendel's Laws.
7. Describe each of the blood types, phenotypically and genotypically.
8. Explain how the events of meiosis explain the observations of Gregor Mendel.
9. Explain how the events of meiosis explain the observations of Thomas Hunt Morgan.
10. Show how the events of meiosis can explain the inheritance patterns of unlinked and linked genes.
11. Using human skin color as an example, explain how trait can be polygenetic.
12. Distinguish between autosomal inheritance and sex-linked inheritance.
13. Besides the XX, XY system of humans, explain how sex is determined in other organisms like birds, bees, and alligators.
14. Explain the process of X inactivation in humans. Relate this to Barr bodies. How does this help explain why the trimsomies of XXY (Klinefleter's) and XO (Turner's) are not fatal like most other trimsomies.
15. Explain the genetic patterns of epistasis and pleiotropy.
16. Give examples in humans and other organisms of how the environment can affect gene expression.
17. Explain and compare various techniques for diagnosing genetic disorders: in utero techniques such as amniocentesis & chorionic villi sampling; preimplantation genetic diagnosis; and newborn screening.
18. Review how mistakes in meiosis (nondisjunction) can lead to zygotes with an abnormal number of chromosomes as in Down syndrome, Klinefelter Syndrome, and Turner Syndrome.
19. Explain and apply the Chi-square statistical method to results obtained from genetic crosses (as in our *Drosophila* experiment).
    - Properly state a null hypothesis.
    - Given data from genetic crosses, calculate expected values.
    - Calculate the chi-square statistic for observed results and expected values and evaluate it using a table of values.
20. Evaluate the genetic inheritance patterns of human traits using a family pedigree.
    - In a pedigree, explain how to distinguish between recessive and dominant disorders as well as between autosomal and sex-linked patterns.
    - Create a pedigree based on given family phenotypes using the proper symbols for a pedigree
21. For the following human conditions, explain the genetic inheritance pattern and the main significant features of the condition (if discussed in class):
    - Cystic Fibrosis
    - Tay Sachs
    - Huntington's Chorea

- Hemophilia
- Colorblindness
- Muscular Dystrophy
- Marfan's syndrome
- Sickle cell anemia
- PKU
- Retinoblastoma
- Achondroplastic Dwarfism
- Androgen Insensitivity Syndrome
- Down Syndrome, Klinefelter's syndrome, Turner's syndrome
- SCID (Severe Combined Immune Deficiency)
- Prader-Willi syndrome (and Angelman Syndrome) – example of epigenomic inheritance

22. Mitochondria contain DNA. Explain how these genes would be inherited differently than genes in the nucleus.
23. Regarding epigenetics:
    - What is it?
    - How do the inheritance of Prader-Willi syndrome and Angelman syndrome support the existence of epigenetic inheritance?
    - Explain the experiment with agouti mice (blond, obese mice and the brown, thin mice) and a change in diet (foods rich in Vitamin B12 which are used to make methyl tags) that support the existence of epigenetic inheritance.
    - How can identical twins be so similar when they are young but quite different when they are older adults?
    - Explain how the experiments with licking behavior of mother mice supports the existence of epigenetic inheritance.
    - Explain the correlation seen in the Swedish population between diet of grandparents and the health of their grandchildren. How doe this support epigenetics?
24. You have many practice genetics problems available in your text and in the binder. Practice many problems so that you become efficient working all types of genetics problems.
25. Even though it is extra credit, I highly recommend doing the study guide for this particular unit, especially the practice problems.
26. Each chapter has some multiple choice questions and a few other additional questions at its end. Give these a try. You might see them again!

Essay Question: There will not be a major essay on the genetics tests. Rather, there will be several genetics problems for which you must show your work. The essays below are really large genetics problems:

1. A new species of fly was discovered on an island in the South Pacific. Several different crosses were performed, each using 100 females and 100 males. The phenotypes of the parents and the resulting offspring were recorded.

   Cross I: True-breeding bronze-eyed males were crossed with true-breeding red-eyed females. All the F1 offspring had bronze eyes. F1 flies were crossed, and the data for the resulting F2 flies are given in the table below.

F2 Phenotype	Male	Female
Bronze eyes	3,720	3,800
Red eyes	1,260	1,320

   Cross II: True-breeding normal-winged males were crossed with true-breeding stunted-winged females. All the F1 offspring had stunted wings. F1 flies were crossed, and the data for the resulting F2 flies are given in the table below.

F2 Phenotype	Male	Female
Normal wings	1,160	1,320
Stunted wings	3,600	3,820

   Cross III: True-breeding bronze-eyed, stunted-winged males were crossed with true-breeding red-eyed, normal- winged females. All the F1 offspring had bronze eyes and stunted wings. The F1 flies were crossed with true- breeding red-eyed, normal-winged flies, and the results are shown in the table below.

Phenotype	Male	Female
Bronze eyes, stunted wings	2,360	2,220
Bronze eyes, normal wings	220	300
Red eyes, stunted wings	260	220
Red eyes, normal wings	2,240	2,180

   (a) What conclusions can be drawn from cross I and cross II? **Explain** how the data support your conclusions for each cross.

   (b) What conclusions can be drawn from the data from cross III? **Explain** how the data support your conclusions.

2. In fruit flies, the phenotype for eye color is determined by a certain locus. E indicates the dominant allele and e indicates the recessive allele. the cross between a male wild-type fruit fly and a female white-eyed fruit fly produced the following offspring:

   (a) Determine the genotypes of the original parents (P generation) and explain your reasoning. You may use Punnett squares to enhance your description, but the results from the Punnett squares must be discussed in your answer.

	Wild-type Male	Wild-type Female	White-eyed Male	White-eyed Female	Brown-eyed Female
F1	0	45	55	0	1
The wild-type and white-eyed individuals from the F1 generation were then crossed to produce the following offspring:					
F2	23	31	22	24	0

   (b) Use a Chi-square test on the F2 generation data to analyze your prediction of the parental genotype. **Show** all your work and **explain** the importance of your final answer.

   (c) The brown-eyed female in the F1 generation resulted from a mutational change. **Explain** what a mutation is, and discuss two types of mutations that might have produced the brown-eyed female in the F1 generation.

   (You will be provided with a table of chi square values, p values, at several degrees of freedom as well as the formula for calculating for the Chi-square value.)

3. An organism is heterozygous at two genetic loci on different chromosomes.

Explain how the behavior of these two pairs of homologous chromosomes during meiosis provides the physical basis for Mendel's two laws of inheritance. (This could be a short answer question.)

4. Assume that a particular genetic condition in a mammalian species causes an inability to digest starch. This disorder occurs with equal frequency in males and females. In most cases, neither parent of affected offspring has the condition. Describe the most probably pattern of inheritance for this condition. Explain your reasoning. Include in your discussion a sample cross(es) sufficient to verify your proposed pattern.

5. State the conclusions reached by Mendel in his work on the inheritance of characteristics. Explain how each of the following deviated from these conclusions: (Each of these could be a short answer question by itself.)
   a. Autosomal linkage
   b. Sex-linked (X-linked) inheritance
   c. Polygenic (multiple-gene) inheritance

6. Discuss the following phenomena in which the sex chromosomes are involved with particular reference to their significance or consequence in humans. ((Each of these could be a short answer question by itself.)
   a. Sex determination
   b. Sex-linked inheritance
   c. Formation of Barr bodies (sex chromatin)
   d. Variation in kinds and numbers of sex chromosomes.