This study guide is no more than a checklist of what you should know for the exam. It is not a substitute for attending class or reading the lecture notes and text. Exam I will consist of 50 multiple choice questions. You can expect to solve some problems. You may use a simple calculator, but no phones or other electronics of any kind are allowed. Anything said in class or noted here is fair game: just because it accidentally didn’t make it to the study guide doesn’t mean it’s not important.

**Introduction to Genetics**

**Know** the three areas of Genetics. What were the contributions of Gregor Mendel, Carl Correns, Erich von Tschemark, Hugo DeVries?

**Know** what a genome is, and how the genomes of different organisms differ in the way they are carried in the organism/structure. (See Figure 1-11 in your text).

**Study** Figure 1-13 in your text for a basic review.

**Read** section 1.3 in your text, for a review of how natural selection and genetics are related. Recall how to read a phylogenetic tree (Figure 1-18).

**Know** the difference between discontinuous/qualitative traits and continuous/quantitative traits. Be able to recognize examples of each.

**Know** the meaning/significance of: morph, polymorphism, wild type, mutant, zygote, ploidy, diploid, haploid, gene, locus, genome, mutation, allele, prokaryote, eukaryote, genotype, phenotype, dominant vs. recessive alleles, heterozygous vs. homozygous.

**Know** the stages of mitosis and meiosis and how they differ. Be familiar with the events that occur during the sub-stages of Prophase I of meiosis.

**Know** what is meant by the Central Dogma. Know what is meant by structural vs. functional (enzymatic) proteins, as well as primary (1°), secondary (2°), tertiary (3°) and quaternary (4°) structure of proteins.

**Know** the four “letters” of the DNA alphabet, and what each one represents.

**Know** the difference between primitive and derived characters.

**Know** the meaning/significance of: monoculture, heterozygosity, homozygosity, transgenic cell, model organism

**Know** the difference between forward genetics and reverse genetics (Read section 1.4 in your text).

**Single Gene Inheritance and Independent Assortment**

**Know** the meaning/significance of: cytogenetics, nucleosome, histone, solenoid, SARs, etc., as well as the different types of chromosomes (as identified by centromere placement), centromere, kinetochore, spindle fibers, nucleolus, NOR, chromomeremes, banding patterns,

**Understand** what is meant by a cross, test cross, reciprocal cross, monohybrid, dihybrid etc. crosses.

**Know** what is meant by single gene inheritance, and how the study of mutants is critical to understanding the function of genes.

**Know** the meaning/significance of: character, trait, true-breeding, hybrid,

**Know** the meaning/significance of Parental, F1 and F2 generations, and how to calculate the number of possible phenotypes, genotypes, and gamete types for any given type of hybrid cross (Punnett square or equations...you pick!).

**Understand** Mendel’s Law of Segregation and Law of Independent Assortment, and how they apply to inheritance.

**Study** Figure 2-7 to understand the significant differences between the three major eukaryotic life cycles.

**Know** the meaning/significance of: meiocyte, germline cell, somatic cell, sexual vs. asexual reproduction, chromosome, chromatid, sister chromatids, homologous chromosomes, dyad, tetrad, bivalent, gametogenesis (and the difference between sperm and ovum development)
Understand the molecular basis of sister chromatid similarity (i.e., DNA replication producing two identical copies)

NOTE: We will be returning to the concept of the difference of alleles at the molecular level in our section on molecular genetics. So you don’t’ need to focus very specifically on pages 44-49—at least for the moment.

Know the difference between autosomes and sex chromosomes. Know the various ways by which sex can be determined in different species.

Know the meaning/significance of: X chromosome, Y chromosome, isogametic species, heterogametic species, homogametic sex, sex linkage, X linkage, Y linkage, pseudoautosomal and differential regions of X and Y chromosomes, hemizygosity, aneuploidy, Turner Syndrome, Klinefelter Syndrome

Be able to calculate expected progeny in both autosomal and sex-linked inheritance.

Understand the basics of pedigree analysis, and be able to read a pedigree and determine the most likely type of inheritance. What is a propositus? A proposita?

Know the meaning/significance of: consanguinous mating, inbreeding, outbreeding,

Understand how mosaic expression effects dosage compensation in female mammals.

Know the contributions of Mary Lyon, Mary Barr, Ewart Bertram.

Know the meaning/significance of: Barr Body, heterochromatin, euchromatin, sex-influenced traits, sex-limited traits, primary/secondary/tertiary sex ratios, sexual dimorphism, cohort, hybrid vigor, heterozygote advantage (read about this on pages 93-94 of your text.)

Know how to calculate the expected ratios of offspring in just about any type of cross I might throw at you.

Statistics in Genetics

Know the meaning/significance of: attribute/qualitative data, discrete numerical data, continuous numerical data, mean, mode, median, range, standard deviation, variance, statistic vs. parameter, Probability calculations vs. Statistical tests

Know how and when to apply the Sum Rule, Product Rule, and Binomial Theorem to calculate combined probabilities of independent and non-independent events. (NOTE: This is VERY clearly spelled out in the lecture notes, and you should NOT have to ask about this!)

Know how and when to apply a Chi Square test. Know how to calculate the degrees of freedom, and look up the Chi square statistic, if given a table of critical values.

NOTE: You need not memorize equations. Just be able to recognize them. I will provide all equations on the last page of the exam.

Know the meaning/significance of: Type I Error, Type II Error

Non-Mendelian Inheritance

Understand the meaning/significance of: polygenic inheritance as it relates to continuous traits

Know the basic mode of inheritance for mitochondrial and chloroplast genes. Understand the phenomenon of maternal inheritance, and the genetic drift behind Cytoplasmic Segregation and Reassortment (CSAR). (What is a cytohet/heteroplasmon?)

Know the meaning/significance of: mitochondrial cytopathy, plasmid inheritance (remember the kal plasmid!), epigenetic inheritance, paramutation, parental imprinting. (We will return to these ideas later in the semester, but for now you should at least know what they mean.)

Mapping Chromosomes

Remember: If you are not already familiar with the details of mitosis and meiosis, use the Cell Division Primer (http://www.bio.miami.edu/dana/dox/cell_division.html) to review.

Understand the details of independent assortment in both linked and unlinked gene loci. Know the meaning/significance of: linked loci, linkage group, parental vs. recombinant gamete configurations, test cross, map function. (We did mapping only for diploid organisms, though it also can be done for haploid organisms much more easily. For this exam, concentrate on the diploid mapping we did. Know only that for haploid crosses you don’t have to worry about
dominance/recessiveness: what you see is what you get! You’ll see this again when we do some microbial mapping after the exam.

Read section 4.8 in your text for a more complete overview of the molecular basis of crossing over.

Know how to calculate measured and actual map distances if I were to give you a batch of baby creatures to count with either two-point or three-point crosses. (Yes, calculators are allowed. But no phones or other electronics. Just the basics.) Be able to recognize reciprocal classes of offspring in such a cohort, and how to tell which locus/loci is/are in the middle and on the outside.

Be able to calculate the coefficient of coincidence and the degree of interference. And actually know what that means.

Understand the basic mechanism and possible effect of somatic crossing over.

Be able to read genetic shorthand such as that shown in Lecture 4 (at the end).

Microbial Genetics

Know the meaning/significance of: prokaryote vs. eukaryote, bacteria, bacteriophage/phage, plating, bacterial colony, bacterial lawn, clone, cell clone, prototroph vs. auxotroph.

Know how bacterial strains can be selected on enriched media or with antibiotics.

Understand the basic processes of conjugation, transformation, sexduction, transduction (and the basic difference between generalized and specialized transduction)

Know the meaning/significance of: F+ and F- E. coli, Hfr E. coli, fertility factor, F’ plasmid (see page 184), donor vs. recipient bacteria, exogenote, endogenote, plasmid, merozygote, pilus, conjugation pore, exconjugant, origin (O) and terminus

Understand what is meant by “rolling circle replication” (for a cute video on rolling circle plasmid replication, see: http://www.youtube.com/watch?v=6EAI4_NGNTM), and what it means that plasmid replicate autonomously.

Understand why a double crossover is necessary for incorporation of exogenote. Your book has a nice diagram on page 182.

Know how tracking the time of a marker gene appearance in bacterial strain can be used in mapping (In addition to the notes, see page 177-180 of your text).

Know how recombinant frequency mapping can be used to generate map distances between bacterial gene loci. (Also see page 181 and Figure 5-15 of your text)

Understand how mapping can be done using phage crosses (as in the linked page showing the different plaque phenotypes produced by the T1 viruses turned loose on poor little E. coli)