Probability and Chi-Squared Practice
Answers these questions on your own sheet. Show all work!

Basic Probability

The first child of two normally pigmented parents has albinism, a recessive trait that results from lack of the pigment melanin. Given that the normal allele is A and the albino allele is a, draw this pedigree and label both phenotypes and genotypes. What is the probability that the second child will be a carrier of the albino gene? Given that the second child is unaffected, what is the probability that he or she is a carrier?

What is the probability that, if three identical coins were flipped, all would end up heads? What is the probability that the three coins would *not* either be all heads or tails?

Phenylketonuria (PKU) is an inherited disease determined by a recessive allele. If a woman and her husband are both carriers, what is the probability of each of the following?
    a. All three of their children will be normal.
    b. One *or* more of the three children will have the disease.
    c. All three children will be afflicted with the disease.

What is the probability that each of the following pairs of parents will produce the indicated offspring (assume independent assortment of all gene pairs)?
    a. $AABBCC \times aabbcc \rightarrow AaBbCc$
    b. $AABbCc \times AaBbCc \rightarrow AAbbCC$
    c. $AaBbCc \times AaBbCc \rightarrow AaBbCc$
    d. $aaBbCC \times AABbcc \rightarrow AaBbCc$

Flower position, stem length, and seed shape were three characters that Mendel chose to study. Each is controlled by an independently assorting gene and has dominant and recessive expression as follows:

Trait	Dominant	Recessive
Flower position	Axial *(A)*	Terminal *(a)*
Stem length	Tall *(L)*	Dwarf *(l)*
Seed shape	Round*(R)*	Wrinkled*(r)*

If a plant that is heterozygous for all three traits were allowed to self-fertilize, what proportion of the offspring would be expected to be as follows? (*Note:* Use the rules of probability instead of a huge Punnet square.)
    a. homozygous for the three dominant traits
    b. homozygous for the three recessive traits
    c. heterozygous for the three traits
    d. homozygous for axial and tall, heterozygous for round

Chi-Squared Practice:

1. A punnett square of a cross Gg x Gg would predict that the expected proportion of green: albino seedlings would be 3:1. A student grew seeds from such a cross and obtained the data below. Use this information to 1) calculate chi square and p then state whether the results were due to chance alone.

Observed

72 GG or Gg (green), 12 gg (Albino)

2. In a study of incomplete dominance, the following results were recorded. Use this information to 1) calculate chi square and p then state whether the results were due to chance alone.

Observed

22 RR, 50 RW, 12 WW

3. An investigator observes that when pure breeding, long wing *Drosophilia* are mated with pure breeding, short winged *drosophilia,* the F1 offspring have intermediate wing length. When several intermediate wing length flies are allowed to interbreed the following results are obtained. Use this information to 1) calculate chi square and p then state whether the results were due to chance alone.

Observed

230 long wings   510 intermediate-length wings   260 short wings

4. You hypothesized that snapdragon flower color is controlled in a co-dominant manner. You created an F_1 population by crossing red and white parents. You selfed the F_1 plants and obtained the following ratio: 31 red, 66 pink, and 27 white flowered plants. Perform an analysis of this data to determine if co-dominant gene action is the correct hypothesis.

For 5-6, use the hypothesis "Purple and smooth are both completely dominant traits."

5. An ear of corn has a total of 381 grains, including 216 Purple & Smooth, 79 Purple & Shrunken, 65 Yellow & Smooth, and 21 Yellow & Shrunken. This ear of corn was produced by a dihybrid cross (PpSs x PpSs) involving two pairs of heterozygous genes resulting in a theoretical (expected) ratio of 9:3:3:1. See dihybrid cross in Table 1. Test your hypothesis using chi square and probability values. In order to test your hypothesis you must fill in the columns in the following Table 2.

6. A large ear of corn has a total of 433 grains, including 271 Purple & Smooth, 73 Purple & Shrunken, 63 Yellow & Smooth, and 26 Yellow & Shrunken. This ear of corn was produced by a dihybrid cross (PpSs x PpSs) involving two pairs of heterozygous genes resulting in a theoretical (expected) ratio of 9:3:3:1. Test your hypothesis using chi square and probability values.