Introduction to Genetics

Section 1: Genetics and Heredity

[2] A young couple expecting a baby is referred to a genetic counselor because the wife, Brooke, has a cousin with undiagnosed mental retardation. Brooke tells the counselor that her cousin John seems autistic to her, but John's family won't talk about his condition. Why do they need to see a genetic counselor?

[3] A litter of cats are born. What might their parents have looked like? If they are all brothers and sisters, why is there such an assortment of coat colors and patterns in these offspring? Why are calico cats only female?

[4] Here are three rows of potato plants and only one row is thriving and producing a crop for the farmer. They are all growing in the same environmental conditions. Why are some plants growing and others not?

[5] The answer to all of these questions can be found in the discipline of genetics and we will investigate them in labs 11 and 12. Genetics is the scientific study of heredity and heredity is the transmission of traits from one generation to the next. You already know how you received those traits…from chromosomes found in your parent's gametes. Stop to answer a few questions in Section 1 of the lab book.

[6] How many traits are inherited? This depends on the organism. Are there traits present on each chromosome? In general, yes. The number varies greatly depending on the chromosome. Are they the same on every chromosome? Not exactly. Let's take a closer look at what is so important about chromosomes.

[7] You learned during the meiosis lab that homologous chromosomes make up a matched pair in a diploid cell. The pairs of chromosomes are separated in meiosis, one set transmitted from each parent, and then replicated through mitosis. Homologous chromosomes are of the same length, centromere position, staining pattern and they also contain *genes!*

[8] A gene is a segment of DNA along the length of a chromosome that codes (or programs) an organism for a particular trait. How it accomplishes the coding we will study in the next lab. It is currently believed that humans have approximately 25,000 genes. Fill in the information about genes in your lab book.

[9] Genes are the reason that chromosomes are considered to be homologous instead of identical. Homologous means similar and homologous chromosomes can carry alternate versions of the same gene. Alternate versions of the same gene are called alleles. The first alleles we will look at today have to do with the seed shape and differences in height in pea plants originally studied by Gregor Mendel. Fill in this important information in your lab book.

Section 2: Mendel Investigates Heredity

[10] Gregor Mendel was a monk who developed ideas on heredity decades before chromosomes were observed under the microscope. He did not know what you already understand about DNA when he published his paper in 1866. He described “heritable factors” that are passed on from parents to produce distinguishable traits in offspring. Make note of this near Mendel’s picture in your lab book.

[11] Mendel studied heredity using *Pisum sativum*, the garden pea. The garden pea displayed many different characters, such as plant height, flower color or seed shape and color. A character is a heritable feature that varies among individuals within a population. The variations within a character like seed shape are called traits. For example, seed shape traits would be wrinkled seeds or round seeds. Use this information to answer a couple of questions in your lab book.

[12] Mendel was wise in his choice of organism to study. He used a plant that was self-fertilizing allowing him control over parentage. He started with true-breeding plant varieties for which self-fertilization produced offspring all identical to the parent. For example, a round-seed variety parent always produced plants with round-seeds. Note the definition for true-breeding in your lab book.

[13] Mendel studied seven different characters in his garden peas, but we will concentrate on just one to begin with…seed shape. To investigate seed shape, he decided to cross-fertilize true-breeding plants displaying two different traits…round seeds and wrinkled seeds.

[14] Mendel began with what are described as parental plants. They are called the P generation. He interrupted self-fertilization by crossing the plants by hand as you see here. He transferred pollen from one parent that was true-breeding for the round seed trait to the stigma of the other parent true-breeding for the wrinkled seed trait and vice a versa. Make note of a few definitions in your lab book as you review the next few slides.

[15] What type of offspring would Mendel get from crossing two *different* true-breeding parents? The offspring would be considered hybrids, because they are plants produced from two parents that differ in one or more inherited traits. Because Mendel was looking at just one character, seed shape, this was called a monohybrid cross.

[16] Seeds of garden pea plants are the peas in the pod. The pea pods that developed after the cross-fertilization of round-seed parents and wrinkled-seed parents contained only round seeds. The first offspring of the P generation are called the filial (fill-E-ul) generation, and are labeled F_1. Why were there no wrinkled-seeds in the F_1 generation? Keep track of Mendel’s findings in the space provided in your lab book.

[17] Even though Mendel did not have the knowledge of chromosomes that you have, he reasoned that the F_1 hybrid offspring must have received a hereditary factor for round seeds from one parent and a hereditary factor for wrinkled seeds from the other parent, but the round trait took precedence.

[18] Mendel labeled the precedent trait (in this case round) the "dominant" trait. He labeled the wrinkled trait "recessive" as it seemed to recede or hide away when joined with the round dominant trait. Here you see the 7 characters Mendel investigated and traits he found to be dominant or recessive. Mendel continued his investigation to find out what happened to the recessive wrinkled trait of the F_1 generation.

[19] Mendel continued by planting the F_1 generation seeds to see what they would produce and therefore was planting all round seeds. The flowers grew; Mendel permitted the F_1 plants to self-pollinate, and waited to see what kind of seeds would be present in the pods of the F_2 generation.

[20] Remember, each pea is an offspring. When the F_2, second filial generation pods were mature, Mendel opened them and discovered both round and wrinkled seeds. How would you explain this finding? Make sure you have kept track of Mendel's findings in your lab book.

[21] Mendel's success in his research of heredity can be partly attributed to his mathematical point of view. Mendel decided to *count* how many peas in the pods were round and how many were wrinkled in the F_2 generation.

[22] He found that about ¾ of the peas were round and ¼ of the peas were wrinkled. Another way of looking at this finding would be to say he discovered a 3:1 ratio of seeds displaying the dominant round trait to the seeds displaying the recessive wrinkled trait. Later in the lab you will see the significance of Mendel's ratios.

[23] Here is a table of Mendel's findings for seven characteristics of pea plants. There is no reason to memorize it…only review and appreciate the work! Look at his results for *plant height* and answer the questions in your lab book based on what you now know about inheritance of dominant and recessive traits and then we'll move on to Section 3.

Section 3: Mendel's Law of Segregation

[24] I think you can appreciate that order of some type exists in these findings. Let's put together what we've learned and see if we can reach each of Mendel's conclusions.

[25] Mendel knew that parents passed on "heritable factors". He deduced that each plant in the F_1 generation received a round heritable factor from one parent and a wrinkled heritable factor from the other parent of the P generation. We now call those heritable factors genes as you have already learned.

[26] Mendel recognized that the heritable factors (or genes) were different depending on the phenotype of the parent plant. The phenotype is the *physical expression* of a trait in an organism inherited in a gene. For example, the phenotype of the dominant seed shape would be round. The phenotype of the recessive seed shape would be wrinkled. Write the definition for phenotype down in your lab book.

[27] Mendel found two different traits for each of the seven characters he studied. Each of those traits we know today to represent alternate versions of the gene for that character. Remember, alternate versions of a gene are called alleles. For example, the gene for seed shape would have two alleles, one representing round and one for wrinkled. Answer a question about traits and alleles in your lab book.

[28] Mendel hypothesized that for each inherited character, an organism inherits two factors, or alleles, one from each parent. Let's allow letters to represent each allele. The two alleles will determine an organism's genotype. A genotype is the genetic composition of an organism determined by the alleles it has inherited. Record this definition in your lab book.

[29] OK, let's imagine that our pea plant inherited the allele for round seeds from one parent and another allele for round seeds from the other parent. The offspring plant's genotype would be homozygous for seed shape and the plant called a homozygote. The term homozygous describes an organism that has two identical alleles for a given gene. Continue to answer questions in your lab book as we go on.

[30] What if a different pea plant inherited the allele for round seeds from one homozygous parent and the allele for wrinkled seeds from the other homozygous parent. This represents the original parental cross made by Mendel. The offspring plant's genotype would be heterozygous for seed shape and the plant called a heterozygote. The term heterozygous describes an organism that has two different alleles for a given gene.

[31] Mendel analyzed all of his data and came to the conclusion that organisms contain two hereditary factors for each character. Those hereditary factors segregate (or separate) from each other so that only one is inherited from each parent at the time of fertilization.

[32] Today we would summarize Mendel's findings by saying that each sperm or egg formed by homologous chromosome separation during meiosis will contain only one of each parent's alleles, representing one trait, for each inherited character. This summary represents Mendel's Law of Segregation. Note this in your lab book to finish up Section 3.

Section 4: Communicating Genetics

[33] To easily express his ideas about heredity, Mendel assigned letters to each trait as you have been introduced to in earlier slides. He chose a capital letter to represent the dominant trait's allele and a lower case letter to represent the recessive trait's allele. It is important to note that the *same* letter is used to represent one character.

[34] Using the character seed shape as an example, the letter for the dominant trait's allele would be a capital "R" for round. This letter would then determine the recessive trait's allele to be a lower case or small letter "r" for wrinkled. You may have noticed that the dominant trait's description tends to determine which letter will be used. Take a minute to fill in the blanks in your lab book at the start of Section 4.

[35] Here you see a sperm carrying the allele for round seeds (R) and the egg carrying the allele for wrinkled seeds (r). The resulting zygote's genotype (Rr) will be heterozygous for seed shape. Remember, a heterozygote has two different alleles for a given gene.

[36] What would be this heterozygote's phenotype? Click on your answer. Remember, the phenotype is the physical expression of inherited traits. To answer this question, remember that Mendel found the dominant trait to have precedence over the recessive trait.

[37] Individuals who have a homozygous genotype can be dominant or recessive. This will make sense if you remember that homozygote's have two identical alleles for a given gene. A homozygous dominant individual would be represented by two capital letters; a homozygous recessive individual would be represented by two lower case letters. Answer a few more questions about genotypes in your lab book.

[38] Take a moment to make sure that you understand all of this information by completing the table of Mendel's observations in your lab book to finish up Section 4. Make sure that you have an instructor sign that you have completed the table correctly before continuing on to Section 5.

Section 5: Gametes, Offspring and Punnett Squares

[39] Let's consider Mendel's law of segregation using these cells. The cells represent a homozygous dominant parent, a heterozygous parent and a homozygous recessive parent. What type of gametes can each parent form?

[40] This animation shows these cells undergoing meiosis I.

[41] Apply all that you have learned about meiosis and Mendel's law of segregation to complete meiosis II. Here we are using sperm, but of course this same meiosis could occur in eggs! Record this information in your lab book and answer the questions below the cells.

[42] Now that you recognize what alleles will segregate into gametes, let's consider the ratios of the genotypes and phenotypes of the F_1 and F_2 generation offspring in Mendel's experiments produced from cross-fertilization of the P generation. Note that cross-fertilization is represented by the letter "x". We'll go back to examining the character seed shape. Here are Mendel's parental plants. Note that this is the cross-fertilization of a true-breeding round-seed plant that would have genotype "RR" with a true-breeding wrinkled-seed plant that would have the genotype "rr". What gametes can each parent produce?

[43] Reminder! Genotypes have two letters per inherited character because genotypes represent diploid organisms. Gametes have one letter per inherited character as they represent a haploid reproductive cell with one allele representing one trait. Let's continue.

[44] Now remember that each parent contributes a gamete to the offspring, so when fertilization takes place, the zygote gets a "R" from one parent and a "r" from the other. Will the offspring be homozygous or heterozygous? Click on the correct answer. It should match what Mendel observed.

[45] Remember that Mendel went on to investigate why all of the F_1 generation produced only round-shaped seeds by allowing the F_1 plants to self-fertilize. The cross of two F_1 plants can be expressed using their genotypes; Rr *x* Rr. What gametes do each produce? Each of the F_1 plants can produce two different gametes.

[46] Now things are getting a little more complicated! You will find that using a handy tool called a Punnett Square will make tracking gamete combinations and predicting offspring outcome a lot easier! Let's learn how with the cross of the F_1 generation.

[47] A Punnett Square represents a mating between two organisms. We are looking at a cross between two heterozygotes from the F_1 generation. Along the left outside vertical of the box list each possible gamete that can be produced by one parent, here the female. On the top horizontal outside of the box, list the other parent's possible gametes, here the male. Remember, one letter represents one trait per gamete.

[48] Bring the gamete letters together in the boxes imitating how they would fuse in fertilization. As you combine each sperm and egg by joining their representative letters in one of the four inner boxes you are predicting all of the possible offspring that can be produced by the mating of the F_1 plants.

[49] Let's read the results from the completed Punnett Square starting with genotype. One box out of four is "RR" – homozygous dominant representing ¼ or 25% of the possible offspring in the F_2 generation.

[50] Two boxes out of four are "Rr" – heterozygous, representing 2/4 or 50% of the possible offspring in the F_2. Note that when you bring a dominant and a recessive allele together, the dominant allele is written first.

[51] One box out of four is "rr" – homozygous recessive, representing ¼ or 25% of the possible offspring in the F_2.

[52] The information from the Punnett square can be translated into a genotypic ratio of the F_2 generation offspring: 1/4 to 2/4 to 1/4…or a predicted 1:2:1 ratio of RR to Rr to rr.

[53] What phenotypes can we expect from this mating? Three boxes contain the genotypes “RR” or “Rr”. Both of those genotypes produce the round-seed phenotype. Only one box has a genotype “rr” that will produce the wrinkled-seed phenotype. So, the phenotypic ratio predicted in the F_2 generation is ¾ round-seed shape to ¼ wrinkled-seed shape, or 3:1 round to wrinkled. This is exactly what Mendel observed.

[54] To check your understanding of what we have gone over, complete the crosses in your lab book starting with plants that are true-breeding for plant height. In this mating Mendel crossed a true-breeding tall plant with a true-breeding dwarf plant. Complete the crosses through the F_2 generation. Then try crossing an F_1 plant with a dwarf plant from the F_2. See you when you get done!

[55] If you wonder about your crosses for plant height, look back at the slides demonstrating crosses for seed-shape. The crosses for plant height should follow the same reasoning…just using different letters!

[56] How did you do on the last cross? Were your parental genotypes different than what you had seen before? The plant from the F_1 generation should have been a heterozygote that produced two different gametes, T and t. The dwarf plant should have been homozygous RECESSIVE – “tt” and could only produce one type of gamete.

[57] If you filled all 4 boxes in your Punnett square that was completely accurate, but not required. Since the homozygous dwarf plant produces only one kind of gamete, it is redundant to write it twice. The genotypic and phenotypic ratios will be the same with two boxes or four boxes. Review them both and prove it to yourself!

Section 6: Mendelian Patterns of Inheritance

[58] Did Mendel’s discoveries explain heredity in pea plants only? No! Mendel’s experiments with garden peas illustrate a basic pattern of inheritance that applies to many different traits, other organisms, and even genetic disease.

[59] In your lab book, you will review Mendelian inheritance by solving a problem with *Drosophila melanogaster,* commonly known as the fruit fly. The problem involves the gene for fly body color that has dominant and recessive alleles. Given the genotypes of the parent flies, you will predict the genotypic and phenotypic ratios of the offspring. See you back here when you are done.

[60] How did that go? Remember, an instructor is always available to help you. Mendelian inheritance can also be seen in human traits and genetic disease. We will explore those in depth in the next lab. As a preview, you will be asked to solve a problem having to do with inherited deafness. Could you predict if a couple has the chance for an affected child? Give it a try!

[61] One more look at Mendelian inheritance, this time in corn. Kernel color in corn is a trait that also involves a dominant and recessive allele. This time you will get two different ears of corn from the demonstration table and work backwards to determine the genotypes of the parents that produced those kernels. Keep in mind, *every* kernel of corn is an offspring! See you when you are finished.

Section 7: Non-Mendelian Patterns of Inheritance

[62] We started this lab by asking some questions about pregnancy, kittens and farming. We can clearly see that heredity is the reason for genetic counseling, kitten diversity and crop failure, but Mendelian patterns of inheritance cannot explain any of those. In the 20^{th} century, geneticists built on what Mendel had discovered to explain different patterns of inheritance. Let's look at one of them.

[63] If Mendel had grown snapdragons instead of garden peas, his findings would have been completely different, as snapdragons have a different pattern of inheritance. The F_1 hybrid offspring of two different true-breeding parents has a unique color. No parental color shows dominance.

[64] Let's look at the different pattern of inheritance with snapdragons. In this image you see in the P generation a true-breeding red snapdragon crossed with a true-breeding white snapdragon. You probably would predict that either red or white would be dominant, and all of the flowers in the F_1 generation will be one color or the other. Once the snapdragons are crossed you see that all of the F_1 generation flowers are pink!

[65] This inheritance pattern is called "incomplete dominance" because the allele for red flower does not completely dominate the allele for white flower. Instead, the heterozygote of the F_1 generation plant has its own phenotype, an intermediate between the two parents. Copy this definition down in your lab book.

[66] It is difficult to find a consistent letter representation used for incomplete dominance so do not be confused by this. Mendelian capital and lower case letters are sometimes used by respected publications. Others use one capital letter describing a character and superscript that letter with a capital letter representing the trait. This method seems preferable to reduce confusion.

[67] Look at the cross of two F_1-generation pink snapdragons as an example: capital letter C would be used to indicate flower color, superscripted by R for red, W for white. You can see that the pink flowers each have one allele for red and one allele for white, so each pink flower produces two different types of gametes. Complete the Punnett square problem for incomplete dominance in your lab book.

[68] Compare Mendelian dominant and recessive inheritance to incomplete dominance. The offspring in the F_2 generation of incomplete dominant inheritance will have a 1:2:1 phenotypic ratio of red to pink to white flower color as well as a 1:2:1 genotypic ratio. What are the ratios for both in this example of Mendelian inheritance?

[69] Incomplete dominant inheritance is seen in the characters of other organisms such as coat color in horses. In humans, incomplete dominance can be observed in hypercholesterolemia, a genetic disease characterized by dangerously high levels of cholesterol that can lead to heart attacks in individuals as young as two years of age.

[70] On the demonstration table you will find tobacco plant seedlings to be counted. In some plants the alleles for green leaf color show incomplete dominant inheritance. Follow the procedure in your lab book using tobacco plant seedlings and solve the problems. Once the instructor initials your work, we'll move on.

Section 8: Independent Assortment of Characters

[71] In this lab we have looked at inheritance patterns that involved only one character at a time. Is one character such as flower color affected by the inheritance of another character such as plant height? Let's return to Mendel's garden where he asked the questions...are characters transmitted from parents to offspring as a unit or is each character inherited independently?

[72] To investigate this question, Mendel performed what is called a dihybrid cross. He chose two parental plants that were true-breeding for two different characters and cross-fertilized them. Let's look at two of the different characters he observed in pea plants; seed shape and seed color. Copy the definition for dihybrid cross in your lab book.

[73] Beginning with the P generation of true-breeding plants for round, yellow seeds and true-breeding plants for wrinkled, green seeds, Mendel performed his first cross. All seeds produced in the F_1 generation showed the dominant phenotypes, round and yellow. Did you take note that there are now 4 letters for each genotype and 2 letters for each gamete? Record this information in your lab book as we move along.

[74] Mendel planted the F_1 generation round, yellow seeds, allowed the plants to grow and self-fertilize to produce an F_2 generation. He examined greater than 500 seeds in the F_2 and found four phenotypes; round yellow, round green, wrinkled yellow and wrinkled green.

[75] Counting the seeds once again allowed Mendel to recognize a pattern of inheritance. He found that the phenotype existed in a 9:3:3:1 ratio. From this pattern he deduced that the heritable factors for each character must assort independently from each other to offspring. This finding was the basis of Mendel's Law of Independent Assortment. Make note of this in your lab book.

[76] Today we would summarize Mendel's Law of Independent Assortment as: the alleles of genes that represent different characters assort independently of each other when gametes are formed in meiosis. For example, the alleles of the gene for seed color segregate independently of the alleles for seed-shape when forming sperm or egg. Record the Law of Independent Assortment in your lab book.

[77] Let's follow Mendel's Law of Independent Assortment inside the cells of the garden peas. Each of Mendel's parental plants had two alleles for seed shape and two alleles for seed color. We now recognize that the two characters were on different pairs of homologous chromosomes. Remember, Mendel came to these conclusions without the luxury of knowing about chromosomes!

[78] A reminder: we are looking at two different characters now and that requires the use of two ***different*** letters. Let's continue to use "R" for the dominant, round trait and "r" for the recessive, wrinkled trait when talking about seed shape. Using "Y" for the dominant, yellow trait and "y" for the recessive, green trait will help us identify seed color.

[79] If you do not understand why a genotype representing two characters should have a total of four letters made up of two different letters ask an instructor now.

[80] When each of these plants produces gametes, recognize that parents only pass on one allele for each character to their sperm or egg. The allele would be the letter that represents the specific trait being passed on. In a gamete for a dihybrid cross, how many total letters do you see present?

[81] OK, let's follow a dihybrid cross. Here, the true-breeding P generation plants are crossed. The offspring or F_1 generation plants will have the genotypes "RrYy". Every offspring is a heterozygote for each character and all will have the phenotype round, yellow seeds.

[82] Mendel permitted the F_1 generation dihybrid plants to self-fertilize. A dihybrid organism is heterozygous with respect to the two genes being considered. Write the definition for dihybrid in your lab book. Then let's think about what gametes a dihybrid could produce.

[83] To help visualize the gamete possibilities, here is a cell of our dihybrid undergoing meiosis I. Look at the location of each allele of the homologous chromosomes as they line up at the metaphase plate before the meiotic divisions. The location of the alleles of the first pair of homologous chromosomes is independent of the arrangement of the second pair. List the possible gamete types from this first arrangement in your lab book.

[84] Here is a second possible arrangement of homologous chromosomes in a dihybrid. Because the chromosomes independently assort, the arrangement of alleles is random and each arrangement has an equal chance of occurring. List these possible gamete types from this second arrangement in your lab book.

[85] A dihybrid, here represented by a plant that is heterozygous for the characters of seed shape and seed color, can produce four types of gametes predictably in equal amounts.

[86] A Punnett square will allow us to see the many offspring that can be produced by the combining of the gametes from this dihybrid cross. Obviously we must use a larger square with room for 4 gamete types on the top horizontal line and 4 gamete types on the left side vertical line.

[87] The inner boxes of this larger Punnett square still represent the genotypes of diploid offspring. They should have two alleles for each character, and therefore will have two R's and two Y's. By convention, each offspring heterozygous for character is written with the capital letter written before the lower case letter.

[88] Make sure that out of the 16 boxes of the Punnett square you can identify Mendel's 9:3:3:1 phenotypic ratio by genotype. Answer the questions in your lab book as you review the chart.

[89] You should be ready to solve problems on your own! In your lab book you have a dihybrid cross using guinea pigs to experiment with. Come back to the program when you are finished.

[90] How did you do? Here are the answers to the P generation cross of the guinea pigs for you to check your answers against. If you did not get these answers, ask an instructor for help.

[91] Check your answers against these solutions for the cross of two F_1 guinea pig offspring. You should be relieved to know when geneticists examine crosses for greater than two traits they use mathematical equations instead of Punnett squares to review offspring ratio.

[92] The last guinea pig problem was a little more complicated. Click on your answer to the very last question here to see if you got it correct.

Section 9: Genes That Are Linked

[93] Mendel studied characters whose genes were found on *different* chromosomes and obeyed the law of independent assortment. There are exceptions to that law for other characters and their genes. It depends on the genes of interest and where they are located.

[94] It's important to remember that there are many different genes on every chromosome. *Drosophila melanogaster*, the fruit fly, has nearly 14,000 genes distributed among a haploid set of 4 chromosomes.

[95] Depending on the characters of interest, some genes are located close together on the same chromosome. For example, in fruit flies the genes that produce body color and wing length are very close together. Make note of this on the chromosomes in your lab book.

[96] In general, genes that are located close together on the same chromosome do not assort independently. They are called linked genes, like the links of a chain, and they tend to be inherited together. Write the definition for linked genes down in your lab book.

[97] Linked genes change how you would predict gamete formation. When genes are linked, linkage does not allow the genes to segregate independently of each other during meiosis. Look at this example of a fly that is a heterozygote for gray body and long wings and copy down the fly's genotype in your lab book.

[98] Keep in mind that the genes for body color and wing length are linked as you take the heterozygous fly through meiosis I and separate the homologous chromosomes by dragging them. You can observe that segregation between the characters of body color and wing length cannot assort independently. Generally, there is no independent assortment between linked genes.

[99] Now take the fly through meiosis II and separate the sister chromatids. You can see that "G" and "L" must segregate together as well as "g" and "l". There will be only two types of gametes formed. In Mendel's gamete formation of a dihybrid, you would have observed independent assortment and the formation of four different gametes. Not with linked genes! Fill in the results of meiosis II in your lab book and solve a problem with fruit flies and linked genes.

[100] Can linked genes ever be separated? Think about the meiosis lab and recall the crossing over you performed between homologous bead chromosomes. Crossing over has a greater chance of occurring the further two genes are apart. If crossing over occurs between the two homologous chromosomes on the screen, what new combinations of gametes will be present? Answer the questions in your lab book…you are almost done!

Section 10: Mysteries to Contemplate and Solve

[101] Our questions at the beginning of the lab have been answered…in part. Heredity is the basis for the outcome of pregnancies, cat fur and crop growth. Brooke's pregnancy risks will be investigated further in the next lab as we discuss human genetics and the inheritance of sex chromosomes. Sex chromosomes will also explain why calico cats are female…what a cliff-hanger!

[102] What about variations in cat fur? You probably need paternity testing to know who the father of your cat's litter is. Geneticists love cat genetics because they are so complicated and involve many different gene *interactions*. Mendelian genetics is present in the inheritance of genes for coat color and fur pattern. What is unique is the way the different genes interact with each other and the environment!

[103] Speaking of the environment, here you see our three rows of potato crops growing next to each other and only one row is thriving. Beetles are destroying the outer two rows. The healthy row was grown from genetically engineered plants that contain a gene from a bacterium, something that never crossed Mendel's mind to be sure. The bacterial gene was inserted into the potato plant to produce a protein making it resistant to beetles. More on genes and proteins in the next lab…

[104] There are extra sample problems and solutions here in the lab book for you in addition to the self-test. You should be well prepared for our next lab on human genetics… you did great work.