NAME _____

DATE _____

Wisconsin Fast Plants®: Monohybrid Genetics

Background

Our modern understanding of genetic inheritance is rooted in the research of Gregor Mendel (1822–1884), an Austrian monk who conducted carefully controlled studies of trait inheritance in pea plants. On the basis of his findings, Mendel developed two important laws. Mendel's first law, the Law of Segregation, states that individuals possess two alleles for each trait, but when organisms are crossed and offspring are produced, the offspring receive one allele from each parent for a particular trait. Thus, the two factors must be separated when gametes are produced. Mendel's second law, the Law of Independent Assortment, says that all traits are inherited independently of one another. (More recently, scientists have found that in some cases, genes are linked.)

Mendel observed these laws at work in garden peas as he discovered patterns in the number of each phenotype occurring in different generations of offspring. Phenotype is a discernable expression of an individual's genetic trait; for example, yellow or white flowers, or wrinkled or smooth seedpods. Mendel's laws help explain heredity (what traits are passed from one generation to the next) and variation (the differences between parents and their offspring).

Mendel also experimentally determined that there could be multiple forms of the same gene. These alternate forms of genes, called alleles, code for slightly different expressions of a genetic trait. He saw that some alleles exhibited dominance and some exhibited a recessive tendency. When a dominant allele was combined with a recessive allele, only the dominant allele was expressed in the phenotype. In modern genetics, a dominant allele is expressed with a capital letter (or letters), and a recessive allele is expressed with a lowercase letter (or letters).

The *Fast Plants* in this kit occur in two possible stem colors, purple or non-purple (green). Plants that display the purple stem phenotype produce a pigment called anthocyanin, while plants that exhibit the non-purple phenotype do not produce the pigment.

In this lab, you will observe a quad of parental generation plants (P_1 and P_2) and grow a quad of first-generation (F_1) plants. After observing the growth and documenting the traits of the F_1 generation, you will plant the F_2 generation of plants. While growing the plants, you will make observations about phenotype and determine the pattern of inheritance for these traits.

Materials

- Wisconsin *Fast Plants*® seeds
- watering trays
- water mats
- anti-algal squares
- growing quads
- potting soil
- quad wicks
- slow-release fertilizer pellets
- plant labels
- distilled water
- beesticks or pollination wands
- permanent marker

Procedure

Day 1

1. Use the following procedures for planting one quad of first generation (F_1) seeds. Your teacher has already planted a quad of parental generation (P_1 and P_2) plants.
   a. Place a quad wick in each cell so that the tip extends halfway out of the hole at the bottom. Then, fill each cell halfway with potting soil.
   b. Add three fertilizer pellets to each cell, and then fill the cell with soil. Avoid packing down the soil.
   c. Press very lightly on the soil in each cell to make a shallow depression. Place two or three seeds in each cell.
   d. Sprinkle enough soil over each cell to cover the seeds. Water each cell with distilled water until water drips from the wick.

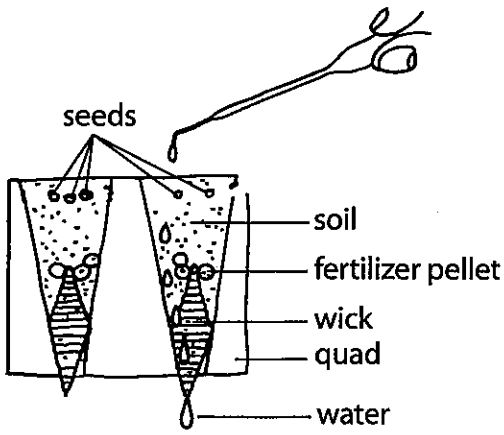

Figure 1. Arrangement of materials in quad cells

   e. On a plant label, write your group number or your initials and the plant generation. Insert the label into the quad.
2. Observe the color of the stems of the young parental generation (P_1 and P_2) plants that your teacher planted. Record your observations in Table 1.
3. Gather class data on the P_1 and P_2 plants, and record the information in Table 2.
4. Answer questions 1–3.

Days 2 and 3

1. Make sure that the watering system remains full. Replace the water with distilled water only.

Days 4–7

1. Each day, make sure that the watering system is full.
2. **On Day 4:** Thin your F_1 quad to one plant per cell. If any cells do not have plants, transplant a seedling from another cell into the empty one.
3. Observe the color of the stems of the young F_1 plants. Record your observations in Table 1.
4. Gather class data on the F_1 generation and record it in Table 2.
5. Answer questions 4 and 5.

Days 8–12

1. Continue monitoring the plants. Keep the watering system full.

Days 13–18

1. Use a beestick or pollination wand to cross-pollinate your F_1 plants. Brush the bee or wand over the flowers to pick up and distribute pollen. Make sure to cross-pollinate the plants, as these plants do not self-pollinate. Repeat this step every class period through Day 18.
2. **On Day 18:** Pinch off any unopened buds.

Days 19–40

1. Continue monitoring the plants and maintaining the watering system. Observe the formation of seed pods on the plants.
2. **On Day 40:** After your observations, remove the plants from the watering system and allow them to dry for 5 days.

Day 45

1. Over a paper towel, gently roll the dry seed pods from one plant between your fingers. Collect the seeds. These are the F_2 generation seeds.
2. Plant the F_2 generation seeds just as you planted the F_1 generation seeds on Day 1.

Days 49–52

1. Observe the stem color of the F_2 generation plants. Record this data in Table 1.
2. Gather class data on the F_2 generation and record it in Table 2.
3. If directed by your teacher, perform a chi-square test to analyze the class results. Refer to the Appendix as necessary.
4. Answer all the remaining questions.

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Table 1: Group Data

	Number of Plants with Purple Stem Phenotype	Number of Plants with Non-Purple Stem Phenotype
P_1		
P_2		
F_1		
F_2		

Table 2: Class Data

	Number of Plants with Purple Stem Phenotype	Number of Plants with Non-Purple Stem Phenotype
P_1		
P_2		
F_1		
F_2		

Questions

1. Explain how you will answer the question of whether stem color is genetically determined or based on an environmental condition.

2. If a single gene, two alleles, controls stem color, how will you determine which color is dominant and which is recessive?

3. State your hypothesis about the inheritance of stem color in Wisconsin *Fast Plants*. Explain what you expect to see in the F_1 generation.

4. Does the data you collected on the F_1 generation support your hypothesis? Why or why not? Revise your hypothesis if necessary.

5. Based on your original or revised hypothesis, explain what you expect to see in the F_2 generation.

6. Based on your data for the F_2 generation, do you accept or reject your hypothesis? Explain your answer.

7. Based on your observations, which trait is dominant and which is recessive? Give evidence to support your answer.

8. Based on your lab data, what is the most likely genotype of each parental generation and the F_1 offspring generation?

9. What additional cross(es) could you do to verify your hypothesis? How would the cross verify your hypothesis?