Name _____ Class _____ Date _____



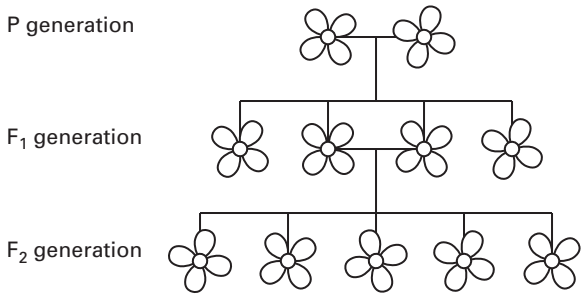
# Family Reunion in a Dish

*Determining P Phenotypes From $F_1$ and $F_2$ Phenotypes*

**Question** How can you determine the traits of a plant from the P generation by observing the traits of the $F_1$ and $F_2$ generations?

**Lab Overview** In this investigation, you will germinate seeds from two consecutive crosses of Wisconsin Fast Plants®. By observing the stem color and height of the seedlings, you will determine the patterns of inheritance and the phenotypes of the P generation.

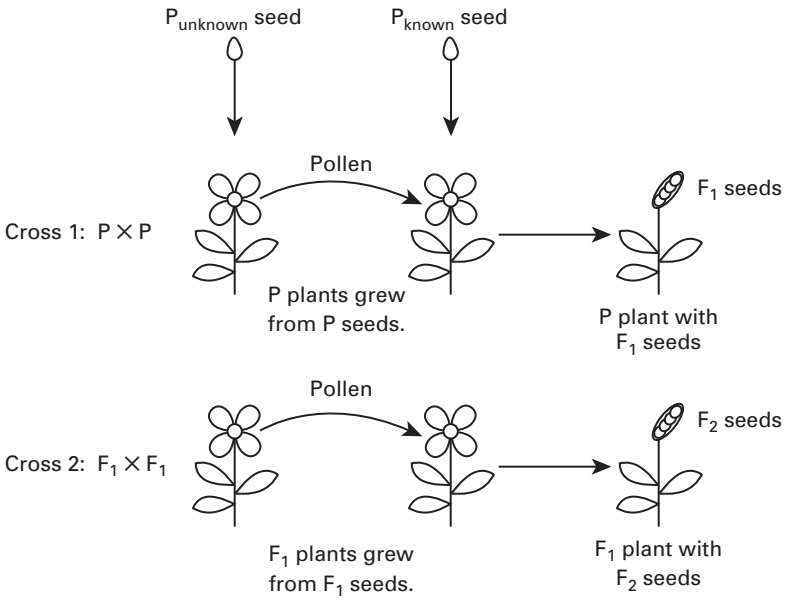
**Introduction** To start your investigation, you will find out more about the three types of Fast Plant seeds that your class will germinate (grow into seedlings) in the lab. Each seed type will grow into plants with the traits of one of the three generations shown in the diagram below. For example, your group may germinate seeds that grow into plants with the traits of one of the true-breeding parent plants (P generation). Another group will germinate seeds with the traits of the $F_1$ generation plants, and another group will germinate seeds with the traits of the $F_2$ generation plants. By observing the phenotypes and the patterns of inheritance of two traits, you will be able to accurately determine the phenotype of the "unknown" parent plant (P generation).




**Background** A *cross* occurs when sperm from one flower (contained in pollen) fertilizes eggs in a flower of a different plant. Seeds of the next generation of plants develop within the fertilized flower. Fast Plant seeds germinate in only 2 days. Within just 4 days the seedlings are large enough to easily observe many genetic traits, such as height and stem color.

**Prelab Activity** A Fast Plant can have a tall or dwarf (rosette) phenotype. The gene that determines height has two alleles, tall *T* and dwarf (rosette) *t.* Each individual plant has either a *Tt, TT,* or *tt* genotype for height. The *T* allele is dominant, and the *t* allele is recessive. Plants that are heterozygous (*Tt*) or homozygous dominant (*TT*) show the tall phenotype. However, plants that are homozygous recessive (*tt*) show the dwarf (rosette) phenotype.

Study the diagram showing two consecutive crosses of Fast Plants. Then, answer the Prelab Questions.




## Prelab Questions

**1.** How many generations of Fast Plants are represented in the above diagram? Identify them.

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**2.** How are seeds produced to grow the next generation of Fast Plants?

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**3.** Which cross was performed to produce $F_2$ seeds?

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Name _____ Class _____ Date_____

**4.** If some plants grown from the $F_2$ seeds had the dwarf (rosette) phenotype and others had the tall phenotype, what could you infer about the genotype and phenotype of the $F_1$ plants?

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**5.** Fast Plants do not normally self-pollinate. Why is this helpful to scientists performing genetic crosses with Fast Plants?

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## Materials

- plastic petri dish
- paper towel
- pencil
- scissors
- permanent marker
- 30 Fast Plant seeds representing P, $F_1$, or $F_2$ generation
- tape
- water reservoir (plastic margarine tub or deli container)
- fluorescent light source (optional)



## Procedure

### Part A: Growing the Seedlings 

**1.** Trace the outline of the petri dish with a pencil onto a paper towel. Use scissors to cut out the circle. Place the circle into the bottom of the petri dish.

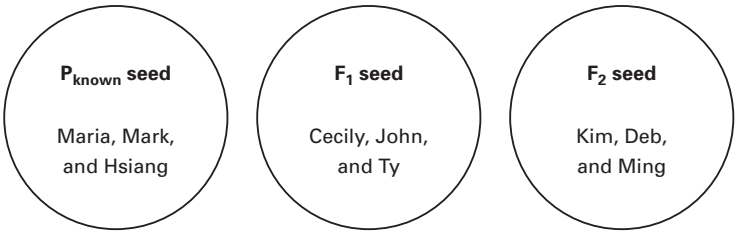
**2.** Your group will be assigned one of the following types of seeds. Each type of seeds will grow into plants with the traits of one generation. You will collaborate with your classmates to observe the traits of the other generations.

$P_{known}$ = true-breeding parent plant (pollen recipient)

$F_1$ = 1st-generation offspring plants

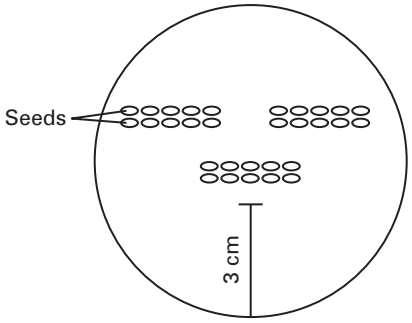
$F_2$ = 2nd-generation offspring plants

With a permanent marker, label the back of the bottom half of the petri dish as shown below to indicate the generation of seeds assigned to your group. Note that no one in the class will have seeds representing $P_{unknown}$—the parent plant that donated pollen. Instead, you will figure out what this plant looked like by observing the traits of $P_{known}$, $F_1$, and $F_2$ plants.

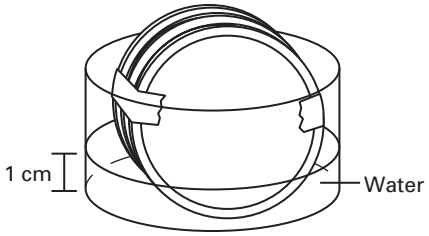



**3.** Add water so that the paper towel is soaking wet. Carefully pour any excess water out of the petri dish.

**4.** Place 30 seeds of the generation you were assigned on the paper towel as shown below. Leave the lower 3 cm without seeds. **CAUTION:** *Handle seeds and plants only as directed. If you have allergies to certain plants, advise your teacher before handling any plant materials.*




**5.** Put the lid on the dish. When other teams have finished placing their seeds, group together 3 plates (one of each seed type) and tape them together in a stack. Stand the plates in the water reservoir. Add water to the water reservoir so that the bottom 1 cm of the petri dishes is submerged.



Name _____ Class _____ Date_____

6. Place the water reservoir with your petri dish in a sunny location (windowsill) or under a fluorescent light source. **CAUTION:** *If using a fluorescent light source, move the light carefully to avoid breakage. Take care not to spill water on or near the light source, and follow all electrical safety rules.*

7. Each day, observe the emerging seedlings. By the fourth day, they should be ready to analyze.

## Part B: Comparing the Phenotypes of the Seedlings

1. Observe your seedlings and the two sets of seedlings of other classmates that were grouped with yours. Study the color of the stems and leaves in all three generations. Record the two variations of this genetic trait you observe. Also record any other differences in phenotype you observe among the three generations.

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2. Fill in Data Table 1 for the stem color trait of your seedlings.

**Data Table 1: Group Data**

| Variation (phenotype) | # of $P_{known}$ | # of $F_1$ | # of $F_2$ |
|---|---|---|---|
| | | | |
| | | | |

3. Pool the data from all the groups in your class for the stem color trait. Fill in Data Table 2.

**Data Table 2: Class Data**

| Variation (phenotype) | # of $P_{known}$ | # of $F_1$ | # of $F_2$ |
|---|---|---|---|
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**4.** Study the overall height of the seedlings. What variations do you observe?

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**5.** Fill in Data Table 3 for the plant height trait in your seedlings.

**Data Table 3: Group Data**

| Variation (phenotype) | # of $P_{known}$ | # of $F_1$ | # of $F_2$ |
|---|---|---|---|
| | | | |
| | | | |

**6.** Pool the data from all the groups in your class for the plant height trait. Fill in Data Table 4.

**Data Table 4: Class Data**

| Variation (phenotype) | # of $P_{known}$ | # of $F_1$ | # of $F_2$ |
|---|---|---|---|
| | | | |
| | | | |

**7.** Record the inheritance of both traits together for your group's seedlings in Data Table 5.

**Data Table 5: Group Data**

| Combined Phenotype | # of $P_{known}$ | # of $F_1$ | # of $F_2$ |
|---|---|---|---|
| Purple stem/ tall | | | |
| Purple stem/ dwarf (rosette) | | | |
| Green stem/ tall | | | |
| Green stem/ dwarf (rosette) | | | |

Name _____ Class _____ Date _____

**8.** Record the pooled class data inheritance of both traits together in Data Table 6.

**Data Table 6: Class Data**

| Combined Phenotype | # of $P_{known}$ | # of $F_1$ | # of $F_2$ |
|---|---|---|---|
| Purple stem/ tall | | | |
| Purple stem/ dwarf (rosette) | | | |
| Green stem/ tall | | | |
| Green stem/ dwarf (rosette) | | | |

## Analysis and Conclusions

**1.** From the pooled class data in Data Table 2, calculate the ratio of the phenotypes for stem color in the $F_2$ generation.

**2.** Based on your class data for the $F_2$ generation, is the genotype for stem color in the $F_1$ generation heterozygous, homozygous dominant, or homozygous recessive? Explain.

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**3.** From the pooled class data in Data Table 4, calculate the ratio of the phenotypes for plant height in the $F_2$ generation.

**4.** Based on your data for the $F_2$ generation, is the genotype for height in the $F_1$ generation heterozygous, homozygous dominant, or homozygous recessive? Explain.

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**5.** Based on your data, what stem height and color traits did $P_{unknown}$ have? Explain your conclusion using supporting data. Explain which variation of each character is dominant.

**6.** Based on the class data for both traits at the same time, calculate the ratio of the phenotypes in the $F_2$ generation.

| Phenotype | Ratio Number (reduced) |
|---|---|
| Purple stem/ tall | |
| Purple stem/ dwarf (rosette) | |
| Green stem/ tall | |
| Green stem/ dwarf (rosette) | |

**7.** Does the data from your class approximate the 9 : 3 : 3 : 1 ratio that Mendel predicted for a dihybrid cross? If not, what might explain the difference?

**8.** Now that you have determined which stem color allele is dominant, decide on a letter to represent both alleles. Using *T* for tall and *t* for dwarf (rosette) and the letters you decided on for the color alleles, go back to Data Table 6 and fill in the possible genotypes for each phenotype next to the table.

## Extension

Design a new cross between two specific genotypes of the $F_2$ generation and predict the genotypes and phenotypes of the next generation.