Who's the Father?

Student Notebook Pages

YOUR CHALLENGE

The goal of this investigation is to determine... ***Who's the Father?*** **You and your classmates will gather evidence to explain how stem and leaf color in Wisconsin Fast Plants™ are inherited. From your evidence and explanations, you will predict the phenotype of the father (P_2) generation.**

ACTIVITY

0 **Work in pairs.** Each pair of students will **plant** a quad. One cell of each quad will be planted with the seeds of the mother plants (P_1) and the other 3 cells will be planted with the first-generation offspring (F_1).

Refer to the ***Wisconsin Fast Plants™ Growing Instructions*** **for details.**

4–7 **Observe** the stem and leaf colors of the young P_1 and F_1 plants.
Record your observations in the table below.

NUMBER OF PLANTS WITH EACH TRAIT IN THE P_1 AND F_1 GENERATIONS

List Each Phenotype:					
P_1 Generation					
F_1 Generation					

Discard the P_1 plants, but continue to **maintain** the F_1 plants according to the *Growing Instructions* by thinning the F_1 plants to 1 plant per cell.

Explain how you think stem and leaf colors are inherited in Wisconsin Fast Plants™.

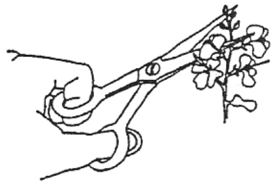
State a testable hypothesis, then **predict** the father's (P_2) stem and leaf colors based on your hypothesis.

Day Activity

15–17 **Intermate** the entire population of F_1 plants over a 3–day period. (*Intermate* means to pollinate plants from the same generation.) Be sure that all flowers receive pollen from several different plants. See *Growing Instructions* for information about making beesticks and pollinating flowers.

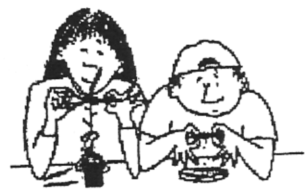
Based on your hypothesis (from day 4-7), **predict** the stem and leaf colors of the second-generation offspring (F_2) that will result from the pollination you did today.

18 **Terminate** (cut off) any new flower buds that were not pollinated on days 15–17.



37 **Stop watering** the plants. Let them dry out for a full week, until they are brown and crispy.

44 **Harvest** the seeds from the pods of the F_1 plants, according to the *Growing Instructions*. These are the seeds of the second (F_2) generation.
Notes or observations:



45 **Plant** the F_2 seeds.

49 **Observe** the stem and leaf colors of the young F_2 plants.
Record your observations in the table below.

NUMBER OF PLANTS WITH EACH PHENOTYPE IN THE F_2 GENERATION

List Each Phenotype:					
F_2 Generation					

DAY ACTIVITY

49 (cont)

Share your results with your classmates.
Perform a χ^2 test to analyze your evidence, using results from the entire class.
Describe your χ^2 results:

Do you accept or reject your hypothesis, based on your evidence? If your hypothesis was accepted, are you convinced that it is correct, or do you need more evidence? If your hypothesis was rejected, what is your new hypothesis? Explain.

Predict the stem and leaf colors of the P_2 plants, based on your (revised) hypothesis.

50 **So...Who's the Father?**
Plant the P_2 seeds.

53 **Observe** the stem and leaf colors of the young P_2 plants.
Record your observations in the table below.

NUMBER OF PLANTS WITH EACH PHENOTYPE IN THE P_2 GENERATION

List Each Phenotype:					
P_2 Generation					

Does the evidence support your (revised) hypothesis? Justify your answer with evidence.

Put Your Results to the Test!

Probability and the χ^2 Test for *Who's The Father?*

Put your claims to the test! Was the ratio of the phenotypes in the F_2 generation what you predicted it would be? Was it even close? A χ^2 test will compare your observations with your hypothesis.

The χ^2 test calculates (1) the deviation between your observed numbers and your expected numbers and (2) the probability that the deviation is due to **chance** or that the deviation is **significant**. If the deviation is merely due to chance, then your results support your hypothesis, and you can **accept** your hypothesis. If the deviation is significant, then your results do not support your hypothesis, and you **reject** your hypothesis.

STEP 1 **Determine the ratio of phenotypes you expected in the F_2 generation, based on your hypothesis.**

Phenotype	**Expected Ratio**	**Expected Number of Plants (*e*)**
1. ____________	______	____________
2. ____________	______	____________
3. ____________	______	____________
4. ____________	______	____________

STEP 2 **Record the ratio of phenotypes you observed in the F_2 generation.**

Phenotype	**Observed Number of Plants (*o*)**
1. ____________	____________
2. ____________	____________
3. ____________	____________
4. ____________	____________

STEP 3 Calculate the χ^2 value. Fill out the following table, using numbers from the entire class.
For *o* and *e* values, use the actual numbers of plants, not percentages or ratios.

List Each Phenotype:	**1**	**2**	**3**	**4**
Observed Value (*o*)				
Expected Value (*e*)				
Deviation (*d*) = *o*-*e*				
Deviation Squared (d^2)				
d^2/e				

STEP 3 *Calculate the χ^2 value, continued.*

Add all of the d^2/e values together to get the χ^2 **value**:

STEP 4 **Calculate the degrees of freedom.**

To calculate the degrees of freedom, subtract one from the number of phenotypes possible.

Number of phenotypes possible *Degrees of freedom*

— 1 =

STEP 5 **Determine whether to accept or reject your hypothesis.**

Find the probability that the deviation of the observed values from the expected values was a chance occurrence. Look up your degrees of freedom in the table below. Find where your χ^2 value falls in that row.

Degrees of Freedom	Probability of Chance Occurrence								
	90%	80%	70%	50%	30%	20%	10%	5%	1%
1	0.016	0.064	0.148	0.455	1.074	1.642	2.706	3.841	6.635
2	0.211	0.446	0.713	1.386	2.408	3.219	4.605	5.991	9.210
3	0.584	1.005	1.424	2.366	3.665	4.642	6.251	7.815	11.341
4	1.064	1.649	2.195	3.357	4.878	5.989	7.779	9.488	13.277

Probability value:

If the probability is 5% or greater, then you can **accept** your hypothesis.
If the probability is less than 5%, then **reject** your hypothesis.

Do you accept or reject your hypothesis?