INVESTIGATION

1-D

STRUCTURED INQUIRY

Skills and Strategies

- Planning and Conducting
- Processing and Analyzing Data
- Evaluating
- Communicating

Safety

- Be sure to pick up all materials after the lab. Beads left on the floor could cause someone to slip and fall.

What You Need

- silver and white paper clips, pipe cleaners, beads, or other materials to represent different alleles (any two colours can be used)

Performing a Monohybrid Cross

A monohybrid cross is performed by breeding two individuals that differ in a particular trait under study. Gregor Mendel never used this term to describe his work, but he did perform monohybrid crosses when he fertilized homozygous dominant purple-flowered pea plants with homozygous recessive white-flowered pea plants. Mendel performed the same type of cross for several other traits in the pea plant. In this lab, you will repeat Mendel's monohybrid cross experiment using a model system, and then analyze your results.

Question

How can you model a monohybrid cross to replicate Mendel's results?

Procedure

1. The homozygous dominant parent is represented by two silver paper clips. The homozygous recessive parent is represented by two white paper clips. Working with a partner, decide who will take the role of each parent.
2. Use a table like the one below to record your results. The table should show the number of times a cross results in each of the possible combinations: two silver paper clips, two white paper clips, or one silver and one white paper clip. Leave space for data from your true-breeding crosses (which result in the F_1 generation) and your F_1 crosses (which result in the F_2 generation). Also leave space to include class results for both the true-breeding and F_1 crosses.

Results of Crosses

	2 Silver	2 White	1 Silver/1 White
F_1			
F_2			
F_1–Class			
F_2–Class			

3. One partner at a time, use this process to perform a cross.
   a) Cup your two paper clips between your palms, shake them, and then close each fist separately around only one paper clip (without looking at the clips or allowing your partner to see them). Keep your fists closed.
   b) Have your partner choose either your left or right hand.
   c) Place the paper clip from that hand on the table.
   d) Repeat this process for your partner's paper clips.
4. Record the outcome of each cross in the F_1 row of your table. Repeat the process nine more times, for a total of ten crosses.
5. Now perform a cross between your first generation "offspring." Each partner will start with the same combination of paper clips that resulted from the tenth cross in your first set of crosses.
6. Repeat steps 3 and 4. This time, record the results of each cross in the F_2 row of your table.
7. When you have collected data for 20 crosses in total (10 true-breeding crosses and 10 F_1 crosses), share your results with the class.
8. Record the class results in your table.

Analyze and Interpret

1. What did each paper clip represent in this model? What did each combination of two paper clips represent?
2. What was the purpose of repeating each set of crosses 9 times?

Conclude and Communicate

3. Calculate the genotypic and phenotypic ratios for the true-breeding crosses and the F_1 crosses for your own data, and then for the class data.
   a) How do each of these ratios compare to the expected ratios? (Hint: Recall the ratios for a comparable F_1 cross shown on page 27.)
   b) If the class results were closer to the expected ratios, why do you think this occurred?
4. The table below shows the results of some of Mendel's monohybrid crosses.
   a) Calculate the phenotypic ratio that resulted from each F_1 cross. Are all of the ratios exactly 3:1? Why or why not?
   b) Notice the number of offspring in the F_2 generation. How do you think using so many plants helped Mendel get results that were close to a 3:1 ratio?
   c) Reflect on your ability to model Mendel's monohybrid crosses effectively. What changes to the procedure you would recommend to improve the intent and results of this lab?

Mendel's Monohybrid Crosses

Trait	Homozygous Dominant Form	Homozygous Recessive Form	F_1 Offspring (from cross between true-breeding plants)	F_2 Offspring (from cross between F_1 plants)
Flower colour	purple	white	all purple	705 purple 224 white
Seed colour	yellow	green	all yellow	6022 yellow 2001 green
Seed shape	round	wrinkled	all round	5474 round 1850 wrinkled
Pod colour	green	yellow	all green	428 green 152 yellow
Stem length	tall	short	all tall	787 tall 277 short