



ABRC: Greening the Classroom Module

Play Mendel 2.0 Student Worksheet (Adapted Activities)

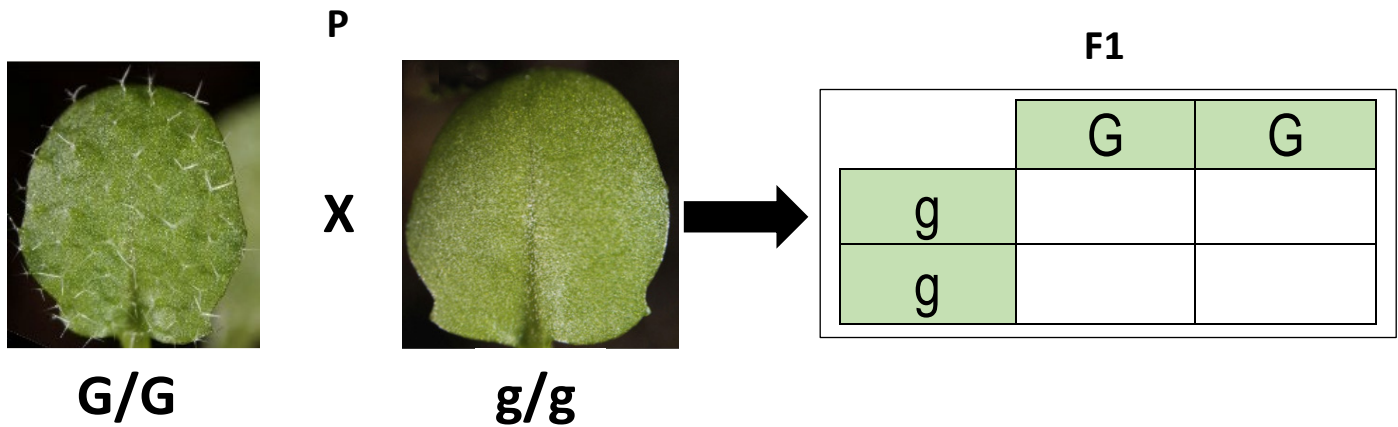
ASSIGNMENT 1 – General terms and phenotypes for the glabrous mutation

1. Define the following terms:
 - Genetic terms - P, F1 & F2 generations, allele, genotype, phenotype, homozygous, heterozygous, mutation, dominant, recessive, sequence
 - Anatomy terms – trichome, sepal, petal, stamen, carpel
2. Explain what the term 'reference strain' means.
3. In this simulated experiment, you will investigate three generations of Arabidopsis to determine the inheritance of the *gl1-1* allele. Read the seed strain details below to learn more about the two strains of Arabidopsis that make up the P generation in this experiment.
 - **Columbia** – This laboratory strain of Arabidopsis is closely related to Col-0, whose genome has been completely sequenced. Col-1 has been used to generate many mutants, and serves as the reference strain for the *gl1-1* mutant used in this module.
 - ***gl1-1***– This strain is homozygous for a mutation in the *GLABROUS1* gene which encodes for a protein involved in trichome (leaf hair) formation. The corresponding reference strain, Col-1, has trichomes on its stem and leaves. The *gl1-1* mutant is glabrous (bald), with very few or no trichomes present on the stem and leaves.
4. Describe the reference and mutant phenotypes in this experiment.

ASSIGNMENT 2 - Complete the F1 generation

NOTE: The genes of interest in this simulated experiment are annotated as GL1-1 and gl1-1. For ease, these annotations are shortened to G and g for this activity.

1. Review the image below that represents the genetic cross between the two parent strains, Columbia and *gl1-1*. Complete the Punnett square to determine the genotypes of the resulting F1 offspring.



2. List the F1 genotypes identified in your Punnett square. Predict the phenotype of each genotype.

ASSIGNMENT 3 – Determine the genotypes of the F2 generation

1. Print Appendix 1 (Play Mendel: *gl1-1* Genotype Activity) and Appendix 2 (Play Mendel: Play Mendel: F2 Genotypes).
2. Cut out each square on Appendix 1. This activity represents the genetic cross of two F1 plants (the plants that resulted from the crossing of the P generation). The grey squares represent the alleles of one F1 plant in the cross. The white squares represent the alleles of the other F1 plant in the cross.
3. Place all of the grey squares in a bowl or bag. Place all of the white squares in a different bowl or bag. Mix the squares in each bowl or bag.
4. Set up your workspace so that you have the Appendix 2 worksheet in front of you, along with the two bowls or bags with the white and grey squares (alleles). Without looking, select and place one white allele in each of the white spaces on Appendix 2. Then, select and place one grey allele in each of the grey spaces. Fill all boxes on the worksheet for a total of 12 pairs.
5. The resulting allele combinations represent the genotypes of the F2 generation. Record the number of each possible genotype for round one in the table below.
6. Repeat steps three through five four more times. Add together the total number of plants in each column and note that sum in the final row.

Round	Number of F2 plants with each genotype			
	G/G	G/g	g/G	g/g
1				
2				
3				
4				
5				
Total				

7. Circle the genotypes that display the reference phenotype: G/G G/g g/G g/g
8. Circle the genotypes that display the mutant phenotype: G/G G/g g/G g/g
9. Based on your answers above, determine the number of reference and mutant phenotypes in each round and for all rounds combined. Next, determine the ratio of reference to mutant phenotypes for each round and for all rounds combined.

Round	# of plants with reference phenotype	# of plants with mutant phenotype	Ratio of reference to mutant phenotypes
1			
2			
3			
4			
5			
Total			

10. Did the ratio from each individual round differ from the ratio obtained from the combined totals?

11. If so, how did the ratio change? Is this what you expected? Explain.

12. Based on the combined ratio you obtained, is the *gl1-1* allele dominant or recessive?

ASSIGNMENT 4 – Phenotypes for the agamous mutation

1. In this simulated experiment, you will analyze the inheritance of the *ag-1* allele. Read the seed strain details below to learn more about the specific strain of Arabidopsis you are investigating.
 - ***ag-1*** – This segregating strain is the result of a cross between two heterozygotes that contain a mutation in the *AGAMOUS* gene. The *AGAMOUS* gene encodes a protein involved in the production of floral organs (sepals, petals, stamens and carpels). The reference strain for this mutant has flowers with all four organs present. In the *ag-1* mutants, the stamens and carpels have been replaced by petals and sepals to produce a “double” flower. The term agamous means “asexual”, which represents the phenotype of the mutant plant which is sterile.
2. This strain produces plants with two unique phenotypes, a single flower phenotype and a double flower phenotype. Which phenotype is the reference and which is the mutant?

Reference phenotype =

Mutant phenotype =

ASSIGNMENT 5 – Analyze the inheritance of the *ag-1* allele


1. Print Appendix 3 (Play Mendel: *ag-1* Phenotype Activity). Cut out each square. Place squares in a bowl or bag. Thoroughly mix the paper squares.
2. Without looking, select and place one paper square on the table so that the flower image is visible. Repeat this step until have 25 squares.
3. Count the number of squares with the reference phenotype and the number of squares with the mutant phenotype. Record that number in the datasheet below. Determine the ratio of reference to mutant phenotypes for this round. Record the ratio on the datasheet.
4. Repeat steps two and three for fourteen more rounds.
5. Add the number of reference phenotypes from each round together and record this total on the datasheet. Do the same for the mutant phenotypes. Determine the ratio of reference to mutant phenotypes for all rounds combined.

Round	# of flowers with reference phenotype	# of flowers with mutant phenotype	Ratio of reference to mutant phenotypes
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
Total			

6. Did combining the data from all 15 rounds cause the ratio to change?
7. If so, explain how and why the ratio changed.
8. Based on the ratio you obtained, is the *ag-1* allele dominant or recessive?

ASSIGNMENT 6 – Punnett Square for *ag-1*

1. Complete the Punnett square below. This will serve as evidence to support your findings from Assignment 5, Question 5.

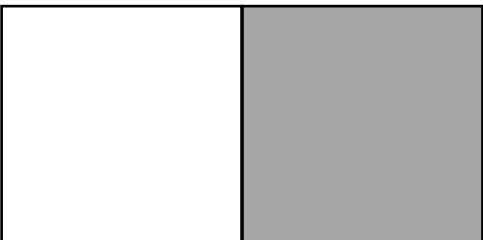
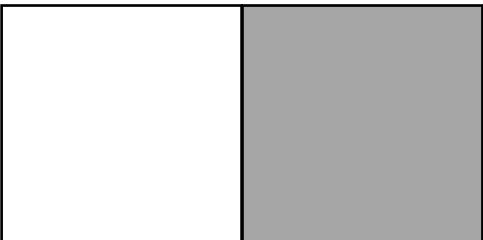
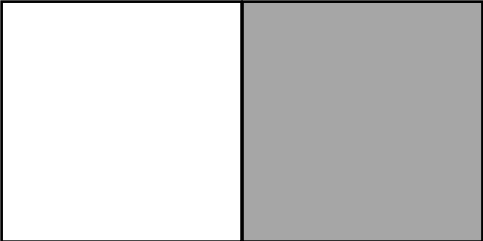
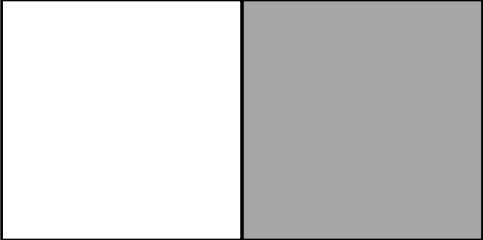
			
		A	a
	A		
	a		

2. Which offspring will display the reference phenotype?
3. Which offspring will display the mutant phenotype?

Appendix 1. Play Mendel: *g1-1* Genotype Activity

G	G	G	G	G	G	G
G	G	G	G	G	G	G
G	G	G	G	G	G	G
G	G	G	G	G	G	G
G	G	gg	gg	gg	gg	gg
gg	gg	gg	gg	gg	gg	gg
gg	gg	gg	gg	gg	gg	gg
gg	gg	gg	gg	gg	gg	gg
gg	gg	gg	gg			

Appendix 2. Play Mendel: F2 Genotypes



Appendix 3. Play Mendel: *ag-1* Phenotype Activity

