BIO LAB:
Wisconsin Fast Plants Monohybrid

TEACHER

LEVEL: Year 11&12 | TOPIC: Genetics | TIME REQUIREMENT: 45 mins

CURRICULUM ALIGNMENT

- *Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes (ACSBL061). Conduct investigations, including the use of probabilities to predict inheritance patterns, real or virtual gel electrophoresis, and population simulations to predict population changes, safely, competently and methodically for the collection of valid and reliable data (ACSBL063)*
- *Represent data in meaningful and useful ways, including the use of mean, median, range and probability; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions (ACSBL064)*
- *Select, construct and use appropriate representations, including models of DNA replication, transcription and translation, Punnett squares and probability models of expression of a specific gene in a population, to communicate conceptual understanding, solve problems and make predictions (ACSBL066)*
- *Frequencies of genotypes and phenotypes of offspring can be predicted using probability models, including Punnett squares, and by taking into consideration patterns of inheritance, including the effects of dominant, autosomal and sexlinked alleles and multiple alleles, and polygenic inheritance (ACSBL085)*

BACKGROUND

Wisconsin Fast Plants are perfect for genetic studies as they are easily grown and allow students to clearly observe the variation of traits among siblings, parents and offspring, through the purple-stem trait. The plants are incredibly useful in illustrating characteristic variation among members of the same species, and how it occurs through genetic inheritance. Using the fast plants, you may choose to stagger seed lines or germinate simultaneously. Students are able to readily count the numbers of purple and non-purple stemmed seedlings. By pooling class results can generate sufficient data to produce the expected second generation's (F2) 3:1 ratio.

In this practical, students observe and record the stem colour of the 2 parental lines, and their F1 and F2 generation offspring. To do this, students prepare seed disks for germination in petri dishes and observe the seedlings; collecting and analysing the data based on their observations of seedling colour. Students make predictions by taking into consideration the patterns of inheritance, including the effects of dominant inheritance. Observations will show Wisconsin Fast Plant seedlings inherit two genes for this stem colour trait, one from each parent. This monohybrid cross study, begins with a homozygous purple stem plant and a homozygous non-purple stem plant. The evidence will also show that there are two versions (alleles) of the gene for stem colour, and the purple allele is dominant, while the non-purple allele is recessive. Through this practical, students gain valuable insight into how characteristics of one generation are passed onto the next and how individuals of the same species and family can exhibit different characteristics.

MATERIALS

- 72-hour Monohybrid Genetics Kit (Contains all required materials for 8 student groups to germinate 1 petri dish, each of 2 homozygous parent stocks (purple and non-purple stems), and the first (F1) and second (F2) generations that result from their cross).
- Light - 24-hour fluorescent light source.

TEACHER TIP

Germinated seedlings may be stored in the refrigerator for up to 2 days if necessary.

SAFETY PRECAUTIONS

- Wear appropriate personal protective equipment (PPE).
- Know and follow all regulatory guidelines for the disposal of laboratory wastes.
- Wash hands thoroughly before and after handling any organic materials.

SOUTHERN Biological

METHOD - STUDENT PRACTICAL

1. Working in a small group, place your seed disks in the bottom of 4 petri dishes for germination. Each petri dish contains a different line of seeds as listed below:

   Parent 1
   - Phenotype observed: non-purple stem.
   - Genotype will be inferred: homozygous anl/anl.

   Parent 2
   - Phenotype observed: purple stem
   - Genotype will be inferred: homozygous ANL/ANL.

   F1 generation (offspring from intermating Parent 1 lines with Parent 2 lines)
   - Phenotype observed: purple stem.
   - Genotype will be inferred: heterozygous ANL/anl.

   F2 generation (offspring from intermating F1 lines)
   - Phenotype observed: a mix of purple stem and non-purple stem that can be analysed to reveal a ratio of 3 purple stem to 1 non-purple stem.
   - Genotype will be inferred through data analysis to be a 3:1 ratio that provides key evidence for inferring the genotypes of the P1, P2, F1, and F2 lines.

2. Moisten the disks using a plastic pipette and place it 10 cm under a 24-hour fluorescent light source. Store at 19-24°c and add a few drops of water each day to ensure the disk remains moist. Be careful not to over-water as submerged seeds are unlikely to germinate.
3. The seeds will germinate within 3 days. Small seedlings will enable you to identify purple and non-purple stem traits.
4. Count the number of seedlings and determine the ratio of purple stem to non-purple stem plants.

OBSERVATION AND RESULTS

Seeds will germinate within 3 days with seedlings that clearly illustrate the purple/non-purple stem traits. After this time, students should observe a 3:1 ratio of purple stem and non-purple stem phenotypes in the F2 generation.

INVESTIGATIONS

- Ask your students to make careful observations on day 3 and analyse their data. Students can then make inferences about the genotypes based on the 3:1 segregation ratio of the purple stem and non-purple stem phenotypes in the F2 generation.
- Task students with proposing hypotheses for how the stem colour trait is inherited in Wisconsin Fast Plants® using the class data to support their hypotheses.
- Ask your students to explain the differences or similarities between Mendel's laws..

EXTENSION EXERCISE

Varying the germination timing of offspring generations and 2 parental lines will generate different data. Germinating Parent 2 a day later allows students time to predict and model its possible phenotype and genotype. Based on the phenotypes they have observed in Parent 1 and the F1 generations, students can predict F2 generation outcomes prior to their seeds germinating to check the accuracy of their hypothesis.