

023 - Monohybrid Genetics with Wisconsin Fast Plants

Supports PA STEELS Standards

- 3.1.6-8.N Develop and use a model to describe why asexual reproduction results in offspring
 with identical genetic information and sexual reproduction results in offspring with genetic
 variation.
- 3.1.9-12.Q Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
- 3.1.9-12.R Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Summary and Timing

Students investigate multiple generations of Wisconsin Fast Plant seedlings. P1, P2, F1, and F2 seedlings are analyzed for stem color at 4-6 days old to discover monohybrid inheritance patterns. The seedlings are easily grown on filter paper and can be thrown away or transferred to a pot with soil after the investigation. The lab kit includes a small greenhouse, seeds, and planting supplies. Suggested timing - 1-2 active class periods, 4-5 inactive days to germinate the seedlings.

Materials *Teacher Provided (view materials)

- Greenhouse or grow light
- Wisconsin Fast Plant seeds, 4 types P1 non-purple stem (homozygous recessive), P2 purple stem (homozygous dominant), F1 purple stem (heterozygous), and F2 purple and non-purple stems (3:1)
- Petri dishes
- Filter paper
- Water bath container
- Forceps

Suggested Background Resources

Visit the Wisconsin Fast Plants website to learn more about these plants.

Guiding Questions

Create a genetic model to explain the inheritance pattern in the Wisconsin Fast Plant seedlings.

Teacher Notes and Set-Up Instructions

Anthocyanin, a purple pigment found in plants, and the trait of interest in this monohybrid cross is best observed in the stem color on days 4-6. Germinate the seeds on day 0 and observe the seedlings on day 4-6. The characteristics of the seed types are described below. Share this information with the students as needed.

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- One gene controls stem color, simple dominance the stems are either purple (dominant) or not-purple (recessive). Anthocyanin, a purple pigment found in plants, and the trait of interest in this monohybrid cross is best observed on days 4-6.
- P1 = parent 1 is homozygous recessive. Genotype: anl/anl. Phenotype: non-purple stem, hairless
- P2 = parent 2 is homozygous dominant. Genotype: ANL/ANL. Phenotype: purple stem, hairy
- F1 = heterozygous offspring from a P1 x P2 cross. Genotype: ANL/anl. Phenotype: purple stem
- F2 = 3rd generation offspring from a F1 x F1 cross. Genotype ratio: 1:2:1 for ANL/ANL: ANL/anl: anl/anl. Phenotype ratio 3:1 purple to non-purple stems.

Procedure - days 0-3

- 1. Plan the "day 0" planting date so that you can observe the seedlings on day 4, 5, or 6. Recommended planting dates are Mondays, Thursdays, or Fridays.
- 2. On day 0, follow the petri dish protocol, but place only 10 seeds per dish. You will need 8 dishes for F1, 8 dishes for F2, and 8 split dishes for P1 and P2.

petridishprotocol.pdf

- 3. Place the dishes under 24-hour lights. The lights should be close to the dishes. Add water as needed.
- 4. Students can observe and measure the germination process, they will notice daily changes. View <u>p. 8 of the Wisconsin Fast Plant activity guide</u> for a measurement and graphing activity. Students can <u>read about how the Wisconsin Fast Plants were developed</u> through selective breeding.

Procedure - day 4 or 5

- 1. Tell the students that we want to observe the traits of the plants and determine if any of the traits can be explained using a genetic model.
- Provide each student group with a tray of F1 seedlings and instruct the students to create a sketch of one of the plants and label the physical characteristics they observe, such as color, shape, size, or texture.
- 3. Compile a class list of the observable plant traits. As a class, agree on 4 traits to observe. Stem color must be 1 of the 4 traits. Students typically include stem color in their list, but you may need to suggest 'stem color' in some classes. List the 4 traits in the first column of the data table.
- 4. As a group, students observe and record the 4 selected traits in the F1 seedlings.
- 5. Provide each student group with a split tray of P1 and P2 seedlings. Tell the students to observe and record the 4 selected traits in the P1 and P2 seedlings.
- 6. As a class, discuss the observed traits and describe any patterns observed. Project or draw a class data table to support a discussion about which of these traits can be described with a genetic model. Allow students to make mistakes and investigate traits other than stem color as time permits.
- 7. Determine the dominant and recessive stem colors. Purple is dominant and green is recessive, we know this because all of the offspring in a purple and green stem cross show the purple stem.



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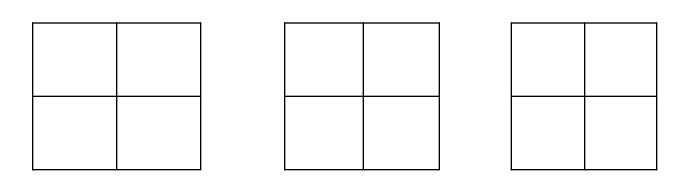
- 8. Complete the Punnett's square to determine P1 and P2 genotype based on the observed phenotype for stem color (GG x gg, Gg x gg). P2 (purple stem) is homozygous dominant and P1 (green stem) is homozygous recessive; the cross between these parents produces 100% heterozygotes (F1) with purple stems.
- 9. Complete the Punnett's square to predict the result of an F1xF1 cross. Crossing two heterozygotes is expected to produce 75% of offspring with the dominant phenotype, and 25% will express the recessive phenotype (3:1). Expressed genotypically, we expect a 1:2:1 ratio of GG, Gg, and gg.
- 10. Provide each student group with a tray of F2 seedlings. How can we test the expectation of a 3:1 phenotypic ratio? Students can count the number of purple and green stems in each tray and calculate a class average the observed average should be close to the expected 3:1.
- 11. The seedlings can be transplanted into soil and pots or thrown away.

Wisconsin Fast Plant Traits

Plant Sketch

Trait	F1	P1	P2	F2

Punnett Squares



P1 phenotype _____ genotype _____
P2 phenotype ____ genotype ____