Solving the Maize: How are Corn Traits Determined?

Target Grade Levels: High School

Subject Areas: Biology

Time Required: 3 to 5 weeks (dependent on growth time and traits observed)

Lesson Objectives:
Make and defend a claim based on evidence that 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.

Apply concepts of statistics and probability to explain the variation of expressed traits in a population.

Materials Required:
- Seed
- Planting material (containers/flats, soil, fertilizer, growing lamp(s) if needed)
- Watering cans
- Spray bottles (for testing)

Lesson Summary
In many public and private research institutions around the Corn Belt, the study of the genetics of maize is of prime interest. Understanding of the plant can lead to improvements ranging from food quality and disaster resistance, to improved access to organic precursor molecules for industrial purposes. The possible everyday impacts of this information, coupled with the number of professionals working in the area with a willingness to help students understand its importance, makes the topic a great central theme for student driven research. Even if corn isn’t as prevalent in your area, there is likely an organism of interest in your area that will allow your students to share in the research experience of area experts.

The student driven research described in this document will be used as part of a project-based unit covering the principles of genetics, guided by the Next Generation Science Standards for Inheritance and Variation of Traits. A partnership with Marna Yandeau-Nelson, Assistant Professor at Iowa State University, and her lab was established through the Research Experience for Teachers program. Marna’s lab focuses on understanding the genetic networks that affect lipid synthesis and modification in maize, specifically on the corn silks. This partnership will aid in helping students pursue understanding of phenotypes expressed by corn during its development. The collaboration allows students to predict and test for genetic concepts, as well as contributing to the relevant research being done today.
Students will form small groups (3-5 students) and decide on the roles they will assume for the duration of the project based unit (see below). As part of the partnership, students will be planting seeds provided by the lab at ISU and will be looking into the expression of surface lipids (glossy mutation vs. wild type). This information will be passed along to the lab, helping them determine particular genotypes without the need for sequencing.

Additionally, students will be determining several other traits and experiment optimizations of their own choosing that they will investigate. Each group will plant a flat of about 50 plants and label the plants in a manner that allows variable testing and monitoring of individual plants. The planting setup provides an opportunity to discuss plant requirements and other related concepts. During initial stages of plant growth, students can be assessed for current understanding and appropriate scaffolding can be used to get students prepared to work with the results of their tests.

During the unit, students will present their experiment plan to ISU lab members and receive feedback. They will also submit a findings document for review.

Differentiation
*The nature of the research students might choose to pursue can be varied significantly. To maintain the partnership established with the lab at ISU, students will be required to investigate a trait that will contribute to the lab’s study. Beyond that, students will be encouraged to investigate traits of their own interest.

*Students will be growing their corn from seed, so many opportunities will be available for the teacher or partner to help the students fill in gaps in understanding.

*As part of the project-based genetics unit, students will be forming groups and each student will assume an interconnected role based on self-identified strengths.

Roles – A Way to Connect to Business

The following are the primary responsibilities for each role, but group success depends on being able to flow into other roles as needed.

- **Project Analyst** – Establishes and maintains the group’s goals and focus.
- **Project Manager** – Determines and adjusts the timelines of the project/unit.
- **Experiment and Resource Manager** – Designs the details of the tests that will be run and makes arrangements for materials needed.
- **Data Analyst and Tech Lead** – Investigates results for significance and prepares communications to share findings (ex. spreadsheets, website, shared documents, telephone/video conferences, emails, etc.)