GENETIC GAMBLERS - TEACHER NOTES

investigating dominant and recessive alleles through phenotypes and genotypes

7.LS3.3 Predict the probability of individual dominant and recessive alleles to be transmitted from each parent to offspring and represent the phenotypic and genotypic patterns using ratios.

INQUIRY-BASED PHILOSOPHY

Inquiry-based learning is a student-centered approach where learning is driven by questions, investigations, and curiosity. Instead of memorizing information, students actively explore real-world problems, formulate their own questions, and seek answers through research and experimentation. This method encourages critical thinking, problem-solving skills, and a deeper understanding of concepts. While it may require more extensive planning and preparation on the part of educators to create meaningful inquiry experiences, the rewards are substantial.

per group of 2 students	*per student*	*whole class*
● 6-sided die ● 4-sided die ● 1 piece of cardstock ● markers	● pen or pencil ● highlighter ● Genetic Gamblers worksheet	● farm backdrop

RUNNING A COMPLEX LAB WITH MIDDLE SCHOOL STUDENTS

Consider using the following techniques to tackle the challenge of a complex lab with middle school students:

- **Teacher Model:** Devote time to illustrating the steps of the lab yourself as the teacher, from step 1 to the final step. It would not be necessary to reveal the results/readings; rather, model the use of the equipment, where you record the data, etc.
- **Teacher/Student Model:** For more student engagement, model the lab from start to finish using students to demonstrate each step or the use of certain equipment.
- **Frontload then Go:** For a class of more independent and motivated students, success is possible through comprehensive frontloading. Instead of going through each step, focus more on the concept of a procedure, where to gather materials, and what to do when they reach a stumbling block. Relate to the real-world scenarios in which students will be given a written procedure and materials and will be asked to complete a project without constant supervision.
- **Check-Ins:** Request that students stop at certain points in the procedure for a check-in from the teacher. This may be at a procedure step that is particularly difficult or one that, if done incorrectly, invalidates the rest of the lab.
- **Work Together:** Instead of giving the lab to students and turning them loose, consider running the lab as a class, noting when each step is finished. Students would only move to the next step once the class does.
- **3 Then Me:** For a class with inquisitive students asking many questions, consider requiring a 3 Then Me policy, where students must ask three of their classmates for help before asking the teacher.
- **Question Cards:** Similarly, consider giving each student a finite number of “Question Cards” - in order to ask the teacher a question, they must relinquish a card. Once they are out of cards, they must ask their classmates for help and work through the problem independently.

LEARNING OBJECTIVES

Students will distinguish genotype and phenotype, identify dominant and recessive alleles, complete Punnett squares, calculate genotype and phenotype ratios, use probability, and explain inheritance using evidence.

GENETIC GAMBLERS SETUP + TIPS

The topic of genetics, especially when using a Punnett square, may be challenging for middle school students. The following tips and suggestions may make the activity run more smoothly:

1. The goal of this activity is to create a classroom herd of pigs. Consider alternative ways for students to create their pigs.
    a. Tech-savvy students could digitally illustrate their pigs.
    b. If you have arts and crafts supplies, allow students to create the pig in 3D! An old plastic soda bottle works well as a “pig body.”
    c. If a STEM program in your school has a 3D printer, explore the possibilities of a combined class project!
2. Regardless of how they create their pig, students may thrive when the teacher applies “theatrics” to the goal of a classroom herd. A farm backdrop has been provided that can be hung inside or outside the classroom to display students’ completed pigs. Consider giving the farm a name and adding a sign. Building excitement around the growing herd can help students stay engaged and focused on the ultimate goal.
3. Wrap-up and further application:
    a. You may ask each group to verbally present their pig including its name, trait genotypes and phenotypes, and one thing they learned about predicting genetics.
    b. Perhaps a school leader could attend the class to view the final herd and the group presentations.
    c. Consider displaying the pasture and herd in a public area of the school for visibility.
    d. A panel could “judge” the pigs and even give ribbons - most unique, most realistic, wildest trait combination; the sky's the limit!
4. Students will work back and forth between the procedure (with examples for support) and the worksheet (where their actual results will be recorded). Consider explicitly showing and reminding them of this to reduce confusion.
5. Consider reinforcing the purpose of each die before students begin. The 6-sided die is used to determine each parent pig’s genotype for a trait. Students then use those parent genotypes to complete a Punnett square and predict possible offspring genotypes and phenotypes. In Part Three, the 4-sided die randomly selects one of the four possible outcomes to determine the trait the new pig will have.
6. Consider walking students through each step before asking them to complete the activity independently. Have a student or even another teacher serve as the other “parent” during your demo so students have a clearer understanding of the process.
7. Also consider completing the lab yourself from start to finish, including the worksheet and final ‘pig.’ While this may take away from the ‘mystery’ of the final outcome, it may help students who struggle with the abstract nature of genetics.
8. It may also help to have a discussion on the traits in this activity and how they differ from real-life traits in pigs. For example, you may ask the class, “Do real pigs have genetics for polka dots? What about floppy ears?” While some traits for this activity are not true to real life, over-the-top traits like more than four legs or polka dots will help us see the variety in outcomes more clearly.