Name: _____

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CASE Curriculum for Agricultural Science Education

Activity 7.1.3 Drosophila Genetics

Purpose

Gregor Mendel discovered how genetic traits are passed from parents to offspring while conducting breeding experiments with peas. Peas germinate and grow rapidly, which enabled Mendel to examine many different generations in a short period. His work showed there are dominant and recessive genes whose frequency can be predicted using probability.

A dominant gene is able to hide or overshadow the effect of other genes. Dominant genes are always expressed in the animal. Recessive genes are only expressed when two are present. In a heterozygous pairing, an animal carrying two different genes, the dominant trait will show in the phenotype or physical appearance of the animal. A homozygous pairing, an animal carrying two of the same genes, is the only way for a recessive gene to show in the phenotype of the animal. Punnett Squares are used to predict the probability of genes and traits occurring in offspring.

Modern geneticists often use Drosophila flies for genetic trials. Drosophila have an even shorter life cycle than peas and demonstrate types of gene action more commonly found in animals. How can you predict the frequency of genetic traits in a population?

Materials

Per pair of students:

- Computer station
- Drosophila Genetics Lab, Version 6.10 software

Per student:

- Pencil
- *Agriscience Notebook*

Procedure

In this activity, you will be conducting simulations of Mendel's experiments for single and double gene inheritance. The experiments you conduct will allow you to predict the mathematic probability of the expected outcome using Punnett Square calculations. Then, to test your predictions, the simulation software will allow you to raise two generations of Drosophila to determine how accurate you were with your predictions.

Part One – Monohybrid Simulation

The first simulation experiment will examine genetic inheritance for a single trait.

1. Your instructor will assign you and your partner one of the following labs:
    - Experiment 1 – Vestigial Wings
    - Experiment 2 – Curled Wings
    - Experiment 3 – Ebony Body
2. Either you or your partner will operate the computer while the other partner records data from the findings.
3. Use the computer simulation program for Drosophila flies for the assigned trait on your lab worksheet.
4. Follow the directions provided on the lab worksheet and complete the results analysis.

5. When you are finished with the first simulation, have your teacher review your findings and correct any errors before moving onto the second simulation experiment.

Part Two – Dihybrid Simulation

In a dihybrid cross, the probability of inheritance for two traits is examined. The Punnett Square grows in size from four squares to sixteen squares to allow for the potential for more genetic combinations. Each parent in a dibybrid cross has four genes, two for each trait. One gene for each trait will be passed on to the offspring.

A heterozygous tall (*Tt*) pea plant with yellow flowers (*Yy*) is represented as *TtYy*. Either height gene may combine with either color gene. The possible arrangements of genes may be determined using the math strategy known as FOIL (First, Outer, Inner, Last).

Possible Gene Combinations for *TtYy*		
First	***T****t****Y****y*	*TY*
Outer	***T****t*Y***y***	*Ty*
Inner	*T****t****Y****y***	*tY*
Last	*T****t***Y***y***	*ty*

The combinations for each parent are used to label each row or column of the Punnett Square. In the example below, both pea plants are heterozygous for both traits. Complete the Punnett Square.

Genes from Pea Plant 2 (TtYy)	**Genes from Pea Plant 1 (TtYy)**			
	__TY__	__Ty__	__tY___	__ty__
__TY__	TTYY	TTYy	TtYY	TtYy
__Ty__	TTYy	TTyy	TtYy	Ttyy
__tY__	TtYY	TtYy	ttYY	ttYy
__ty__	TtYy	Ttyy	ttYy	ttyy

1. For the second simulation experiment, you and your partner will examine gene inheritance for two traits simultaneously.
2. Your instructor will assign you and your partner one of the following labs:
    - Experiment 4 – Vestigial and Ebony
    - Experiment 5 – Curled and Black

6. You and your partner will switch roles for the second simulation. If you were operating the computer and your partner was the data recorder for the first simulation, then you will record data for this simulation and your partner will operate the computer.
7. Record data on the worksheet provided by your teacher. When you are finished with the simulation exercise, complete the results analysis.

Conclusion

1. Use the Punnett Square method and predict the probability of orange body color represented by the letter “O” for a cross between a pairing with “Oo” and “oo” gametes. Show your work below.

	O	**o**
o	Oo	oo
o	Oo	oo

Prediction	
Body Color	**Prediction (Percentage)**
Orange	50%
Yellow (*oo*)	50%

8. What do the capital letters represent for a gamete paring?

Dominant

9. If the parent's body color is red, why is there a chance its offspring may be a different color?

   0% if both of them are 100% dominant for the red trait