

Punnett Square Lesson Plan

Science Objectives

- Students will understand the concepts of recessive and dominant genes.
- Students will simulate a Punnett square on the calculator to determine predicted outcomes of a specific trait.

Resources Needed

Prior to beginning this project, students need:

- TI-73™ Explorer or TI-83/84 Plus Family Calculator
- *Punnett Square* Student Project Card (page 90)
- *Punnett Square* Data Collection Sheet (page 91)
- *Punnett Square* Rubric and Scoring Sheet (page 92)
- *TechTools Resource Kit for the TI Graphing Calculators* “How-to” Cards

Internet Resources

This project uses websites that are linked to the *TechTools Resource Kit for the TI Graphing Calculators* Internet site at <http://www.tcmpub.com/urlupdates/>.

Procedure

Student Preparation

1. Ask students the following questions:
 - Who do your genes come from? (*our mother and father*)
 - What are some inherited traits? (*hair color, eye color, height, etc.*)
2. Review with the students the following basic genetics concepts:
 - Tell students that genes determine many individual traits. At fertilization, one gene comes from the male (*father*), and one gene comes from the female (*mother*).
 - Explain that genes can be either dominant or recessive. Review the different offspring types that can result from crossing dominant and recessive genes.
 - Remind students that a capital letter represents the dominant gene and a lowercase letter represents the recessive gene.
 - Explain that each reproductive cell that is capable of fusing with another reproductive cell is called a *gamete*. When an organism forms a gamete, the pair of genes for a trait is split up. Each gamete receives one gene from each parent. Hence, the offspring will have two genes for each trait, one from the mother and one from the father.
 - Show students the websites linked to the pages at <http://www.tcmpub.com/urlupdates/>. Here students can review information about the Punnett square and dominant and recessive traits.

Procedure (cont.)

3. Read the project card challenge to the students.
 - Explain to students that in this project they will create a simulation of a Punnett square to illustrate the predicted outcomes for the crossing of the long/short beak trait of two heterozygous birds. (Each gamete has one dominant long beak gene and one recessive short beak gene.)
 - Assist students in understanding the function of the numbers in their simulated Punnett squares. Students' Punnett squares should appear like the one below.

Gametes	L (or 1)	l (or 2)
L (or 1)	LL (or 2)	Ll (or 3)
l (or 2)	Aa (or 3)	aa (or 4)

- If students are unsure of how to generate random numbers between 1 and 2 in the lists L1 and L2, assist them by providing them with the following directions: *Highlight L1 or L2 , press the MATH key, highlight PRB (Probability menu), select the Random Integer command (randInt), and type 1, 2, 200) after the parentheses.*
4. Review the use of the “How-to” cards.
 - Review how to enter list formulas.
 - Review how to generate random integers.
 - Review how to create a histogram.
 5. Explain the scoring rubric to students.
 - It is important for students to see the rubric and understand that their grades will be based on how they perform as measured by the rubric.
 - Review the three levels of performance and ask the students at which level they would like to achieve and why.
 - Check for understanding by asking students to describe examples of projects at each level.

Presentation

- Allow students to compare the Punnett squares on the Data Collection Sheet.
- Have students present their own Punnett square situations to the class.

Assessment

- Utilize the rubric to assess students' performances.
- Allow students to assess their own work as well as that of at least one other classmate.

Extension Ideas

- Have students create a poster of the life cycle of the bird.
- Have students complete a Punnett square simulation for another animal.

Punnett Square

Student Project Card

You are an avid bird watcher who particularly enjoys observing the cyclical progression of life among birds in your community. Lately, you have been watching the courtship, nest building, and mating of two birds that have taken residence in the Oak tree in your backyard. Your bird watching club is very interested in the sequence of events occurring in your backyard and has asked you to give a presentation on what you have observed. Since the fledglings have not yet hatched, they have asked you to create a simulated Punnett square on the calculator to predict the outcomes for the inherited trait of long or short beak. A long beak is the dominant traits in this species. A short beak is a recessive trait. Because you observed both of these birds as fledglings last spring, you have quickly reviewed your notes and recall that both birds are heterozygous for this particular trait.

To complete this project you must:

1. Write the genes for the male bird in the first row of the Punnett square on the Data Collection Sheet. Write the genes for the female bird in the first column of the Punnett square. The table next to the Punnett square shows the letters that represent each gene.
2. On the Punnett square, write the number 1 by the dominant genes, and write the number 2 by the recessive genes for each bird. Then, complete the Punnett square.
3. Access the Stat list editor. L1 will represent the genes that are in each gamete for the male bird, and L2 will represent the genes in each gamete for the female bird. Generate 200 random numbers between 1 and 2 in L1 and L2.
4. Join the male bird gametes with the female bird gametes in L3 by adding L1 and L2 together.
5. The numbers 2, 3, and 4 in L3 represent the newly formed gametes for 200 offspring. Determine the types of offspring each number represents by adding the “gene numbers” for each newly formed gamete in the Punnett square on the Data Collection Sheet.
6. Create a histogram of the distribution of the different types of offspring in L3. Input the following values to create a “Friendly” window: $Xmin=2$, $Xmax=5$, $Xscl=1$, $Ymin=0$, $Ymax=150$, $Yscl=1$, $Xres=1$. Use the Trace feature to analyze the graph.
7. Prepare for the question and answer period of your presentation to your bird watcher club by completing the questions on the Data Collection Sheet.

Resources

Bar graphs and averages websites are linked from the pages at <http://www.tcmpub.com/urlupdates/>.

This project is adapted from:

Jeff Lukens and Bob Tower, “Call it...Dominant or Recessive,” *Biology with the TI-83 Plus*.



Punnett Square Data Collection Sheet

Gene	Trait
L	Long beak (dominant)
l	Short beak (recessive)

I. Complete the Punnett square.

Gametes		

II. Sketch the histogram below.

Record the type of offspring and n-values for each bar. Then calculate the predicted outcomes and write them in percent form on the lines below the histogram.

_____ homozygous dominant _____ heterozygous _____ homozygous recessive

III. Analyze the data in the histogram and answer the questions below.

1. Which combination(s) of gametes indicates that the offspring has the dominant trait of a long beak?

2. Which combination(s) of gametes indicates that the offspring has the recessive trait of a short beak?

3. Which trait is the most prevalent among the 200 offspring?

IV. Develop your own simulated Punnett square by crossing a different combination of gametes. Summarize the following components on a separate piece of paper:

- The numerical values of the parent genes and offspring gametes.
- The Punnett square of the cross and the histogram of the frequencies.
- The predicted outcomes for each offspring type.

Punnett Square Rubric and Scoring Sheet

Criteria	Level I (0–4 points)	Level II (5–8 points)	Level III (9–10 points)	Self Score	Peer Score	Teacher Score
Complete the Punnett square with the letters and numerical values.	You did not complete the Punnett square.	You completed the Punnett square, but it is not correct.	You correctly completed the Punnett square with letters and numerical values.			
Sketch the histogram and add the appropriate labels.	You did not accurately sketch the histogram.	You accurately sketched the histogram, but your labels are incorrect.	You accurately sketched the histogram and added the appropriate labels.			
Calculate the predicted outcomes for each offspring type.	You correctly calculated one of the predicted outcomes.	You correctly calculated two of the predicted outcomes.	You correctly calculated all three of the predicted outcomes.			
Answer the questions.	You correctly answered one of the questions.	You correctly answered two of the questions.	You correctly answered all three of the questions.			
Summarize your new Punnett square simulation.	You included one of the three requirements in your summary.	You included two of the three requirements in your summary.	You included all three requirements in your summary.			
Comments:				Total Score		