Edible Genetic Ratios

Introduction

During this activity, students will utilize critical thinking skills to analyze the phenotypes of a "generation" of gummy bears and determine the phenotypic ratios, probable genotypes, original parental cross, and the mode of inheritance.

Grade Level: 8-10
Time Needed: One 45-60 minute class period

Learning Objective

After completing this lesson, students will be able to:

1. Determine the probable genotypes by analyzing the phenotypic frequencies of an F1 generation
2. Determine the probable parent crosses of an F1 generation by analyzing the phenotypic frequencies of an F1 generation
3. Describe the phenotypic effects produced through codominant alleles

Materials

- ☐ Brown paper bags
- ☐ Gummy Bear candies
- ☐ Student Activity Sheets

Instructional Process

Prior to beginning this activity, students should have a basic knowledge of Mendelian genetics and co-dominance of traits.

For the purposes of this activity, Gummy Bears will represent the F1 Generation of a cross breeding experiment. Each bag will contain a pre-determined number of colored bears. The amount of gummy bears placed in each bag will represent Mendelian and non-Mendalian ratios. However, these will not represent ideal ratios, but realistic ratios. In other words, instead of using 30:10, you will use 28:11.

Next Generation Science Standards (NGSS)

As a result of activities in grades 8-10, all students should develop:

Topics

- **MS-LS2**: Growth, Development, & Reproduction of Organisms
- **HS-LS2:** Inheritance & Variation of Traits

Performance Expectations

- **MS-LS3-2:** 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.
- **HS-SL3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Dimensions

Practices:

- Developing and Using Models

Disciplinary Core Ideas:

- **LS3.A:** Inheritance of Traits
- **LS3.B:** Variation of Traits

Cross-Cutting Concepts:

- Patterns

Prior to Classroom Activity

1. Place the following amounts of the appropriate Gummy Bears in each paper bags

Bag 1	29 red gummy bears
Bag 2	24 colorless gummy bears
Bag 3	28 red gummy bears/11 colorless gummy bears
Bag 4	21 yellow gummy bears
Bag 5	32 orange gummy bears
Bag 6	13 red gummy bears/24 orange gummy bears/11 gummy bears

2. Arrange students into small groups of 3-4 people.
3. Give each group a numbered paper bag, and tell them that the bears in each bag are the result of a different cross-breeding experiment.
4. Pass out the Student Activity Sheet and ask students to open their bag and begin to sort the bears based upon phenotypes that can be easily observed and quantified (according to color).
5. Read through the Student Activity Sheet as a class and ask each group to count each phenotype and list their numbers on the board.
6. Using the evidence listed on the board, ask each group to select symbols to represent the alleles for each phenotype.
7. Next, ask them to use the evidence from the board to complete the rest of Student Activity Sheet, including the mode of inheritance as either Mendelian or Co-Dominance.
8. After all students have completed their worksheets, facilitate a discussion of their results. Use the following results table to guide your discussion.

Cross Number	***Phenotypic Frequency***	***Ratio***	***Genotype***	***Model of Inheritance***	***Parental Cross***
1	29 red	100%	RR or Rr	Mendelian	RR x RR or Rr x Rr
2	24 colorless	100%	rr	Mendelian	rr x rr
3	28 red /11 colorless	3:1	RR, Rr, rr	Mendelian	Rr x Rr
4	21 yellow	100%	YY	Co-Dominance	YY x YY
5	32 orange	100%	RY	Co-Dominance	RR x YY
6	13 red /24 orange /11 yellow	1:2:1	RR, YY, RY	Co-Dominance	RY x RY

Edible Genetic Ratios – Student Sheet

Introduction

During this activity, you will utilize your critical thinking skills to analyze the phenotypes of a "generation" of gummy bears and determine the phenotypic ratios, probable genotypes, the original parental cross, and the mode of inheritance.

Materials

- ☐ Brown paper bags containing populations of Gummy Bears

Procedure

1. Obtain a paper bag of gummy bears from your teacher. The bears within each of the bags represent the F1 generation of a cross-breeding experiment.
2. Open the bag and count the number of bears. Record the total number of bears: _____.
3. Sort the gummy bears into groups based upon a phenotypic difference that can be easily observed and quantified.
4. What is the phenotypic characteristic you used to sort the bears? Why?

   _____

   _____
5. Count the number of individual bears for each of the alternate forms of this characteristic and fill it into the appropriate row in the table below.

Cross Number (Bag #)	*Phenotypic Frequency*	*Ratio*	*Genotype*	*Model of Inheritance*	*Parental Cross*
1					
2					
3					
4					
5					
6					

6. Now, write your data on the classroom data table your teacher has copied on the whiteboard or chalk board at the front of the class. As other groups place their data into the table, copy it into the table above. Compare your results with the results of the other teams in the class.
7. Next, using all of the data from the other groups, answer the following questions and complete the above chart.

Follow-Up Questions

1. Explain the gene symbols you use to represent the characteristics of the alleles.

2. Based on the evidence, what are the probable genotypes for each phenotype you observed?

3. What were the probable genotypes of the original parental cross?

4. What were the phenotypes of these parent individuals?

5. Now with the gene symbols chosen, show a Punnett square that will test your hypothesis (i.e. show the predicted outcome of the parental cross that led to the gummy bears in your bag).

6. You have already obtained a ratio based on your data. How closely does the data compare to the ratio predicted by your Punnett square?

7. Based on the evidence, determine the probable modes of inheritance for each bear phenotype observed in class.