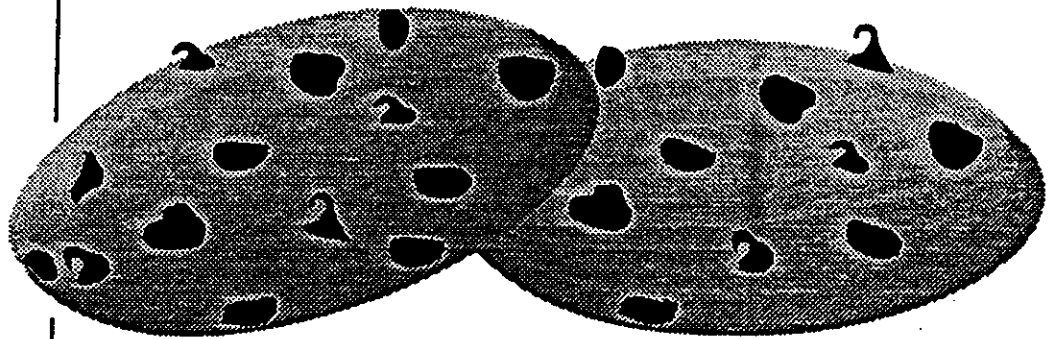


Food for Thought: The Cookie Analogy



A familiar activity (baking cookies) helps to explain unfamiliar genetics concepts

Developed by

Sue Johnson
University of Wisconsin
Science Education, Department of Curriculum & Instruction
Room 226 Teacher Education Building
225 North Mills Street
Madison, WI 53706

Center for Biology Education
University of Wisconsin
660 WARF Building
610 N. Walnut Street
Madison, WI 53705

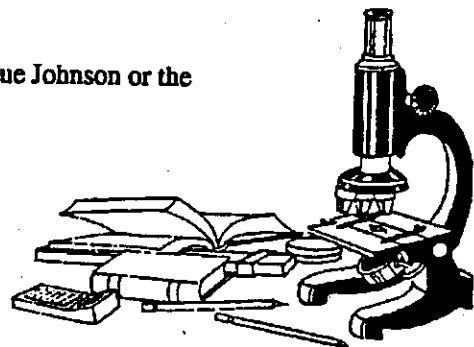
Introduction

Food for Thought: The Cookie Analogy was originally written to introduce a unit on heredity at the high school level. It can be easily adapted for other grade levels or to include other topics. *The Cookie Analogy* is an activity in which the familiar is used to explain the unfamiliar. The familiar in this case would be cookies and cookie recipes, while the unfamiliar would be many biological concepts, including phenotype and genotype. The familiar becomes a model which can be used to help students construct meaning for concepts that often prove to be difficult to learn. It is highly adaptable, as basic concepts such as heredity and environment can be discussed without having to use a great deal of terminology. It can also be used to help students construct meaning for terms that may be commonly used, but often misunderstood.

Food for Thought: The Cookie Analogy developed by Sue Johnson.
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For additional copies of this exercise, contact Sue Johnson or the
Center for Biology Education
University of Wisconsin
660 WARF Building
610 N. Walnut Street
Madison, WI 53705
608/263-0478



Notes for the teacher

As a part of the activity, the students are given the assignment to bake one of four cookie recipes and bring one dozen of the cookies to school. Several days should be allowed before the date of the classroom portion of the activity, to provide adequate time to obtain ingredients and do the baking. Although a majority of students may wish to make a particular cookie, such as the ever-popular chocolate chip, each of the four recipes should be equally represented.

The ingredients of the four recipes have been selected for specific reasons. For example, the two cookies (oatmeal raisin and oatmeal chocolate chip) that have the most similar *phenotypes* (appearances) actually differ the most in terms of their recipes or *genotype* (genetic makeup). The relationship of having a similar appearance and very different recipe is analogous to the relationship between the black and panda bear. In appearance, both bears look similar. However, each has a very different DNA "recipe."

Students are asked to fill out the "Questions for the Baker" worksheet at the time the cookies are made and bring the completed worksheet to class with their dozen cookies. The questions on the worksheet were designed to allow the recording of data that may prove useful to answering the "Discussion Questions" in the classroom.

It is recommended, for several reasons, that the classroom portion of the activity be done in research groups. The enjoyable tone of the lab that begins with the unusual occurrence of bringing cookies to class continues with easier discussions that are common to groups. Working on the Discussion Questions with others in the group also expands the potential for ideas and interpretations, which are later shared with the entire class.

The Discussion Questions are easily adaptable to any particular course of study. The questions can be used to introduce and/or support all of the following concepts: gene, allele, heredity, environment, genotype, phenotype, adaptation, evolution, continuity, diversity, mutation, mutagen, teratogen, taxonomy, and classification. For example, margarine, butter and shortening can be used as examples of *alleles* (forms of a gene). The value of the analogy becomes more evident as it is applied to help the student construct meanings for concepts that are unfamiliar to their daily experience and therefore difficult to understand. At many times in class discussions— days or weeks following this activity— the familiar, concrete example can support the unfamiliar, difficult concept.

One variation to the present activity would be to ask a few students to bake one of the recipes, with only half of the recommended amount of an assigned ingredient, or to omit an assigned ingredient. These changes in the amounts of certain ingredients could vary from being "harmless" to "lethal" depending on the ingredients' importance to the "survival" of the cookie.

The value of this activity increases greatly when it is adapted for use in a particular classroom. One thing found to be generally beneficial is for someone to bring milk!

Lab Activity: Student Guide

The Cookie Analogy

What types of questions are asked by those trying to unravel the mystery of life on Earth? As explorers travelled the globe and returned with great numbers of different organisms, many questions must have been posed as to the significance of the great variety and about how it might have occurred. How could this diversity mesh with the idea of "like begetting like"? Was change a part of the picture, and, if so, how did it occur?

This activity will help us begin to address questions such as these. We will start with a simple example, but one with which we are all familiar: **COOKIES!** To make cookies an official part of "life" on Earth we will declare them an official species with the name *Crustula suavia*, Latin for "cookie sweet."

Procedure

You are assigned to bake cookies, following one of four recipes. Each recipe makes several dozen cookies. Share the cookies with your family and/or friends, but bring one dozen to class on the day the assignment is due. While you are baking, complete the Questions for the Baker worksheet. Bring it to class with your dozen cookies.

Cookie Recipes

Recipe Number One

- 2 1/4 cups all-purpose flour
- 1 teaspoon baking soda
- 1 teaspoon salt
- 1 cup margarine or butter
- 3/4 cup sugar
- 3/4 cup firmly packed brown sugar
- 1 teaspoon vanilla
- 2 eggs
- 1 package (12 oz.) chocolate chips

Preheat oven to 375 degrees Fahrenheit. Beat together margarine, sugar, brown sugar, and vanilla until creamy. Beat in eggs. Combine flour, baking soda, and salt. Gradually add to margarine mixture. Stir in chocolate chips. Drop by rounded teaspoonfuls onto ungreased cookie sheets. Bake for 8-11 minutes.

Recipe Number Two

- 1 1/2 cups all-purpose flour
- 1 teaspoon baking soda
- 1 teaspoon salt
- 1 teaspoon cinnamon
- 1/4 teaspoon nutmeg
- 1 1/4 cups margarine or butter

(continued on page 5)

Cookie Recipes

(continued)

(continued from page 4)

- 1/2 cup sugar
- 3/4 cup firmly packed brown sugar
- 1 teaspoon vanilla
- 1 egg
- 3 cups oats
- 1 cup raisins

Preheat oven to 375 degrees Fahrenheit. Beat together margarine, sugar, and brown sugar until creamy. Beat in egg and vanilla. Combine flour, baking soda, salt, cinnamon, and nutmeg. Gradually add to margarine mixture. Stir in oats and raisins. Drop by rounded teaspoonfuls onto ungreased cookie sheets. Bake 8-11 minutes.☞

Recipe Number Three

- 1 1/2 cups all-purpose flour
- 1 teaspoon baking soda
- 1 teaspoon salt
- 1 1/4 cups margarine or butter
- 1/2 cup sugar
- 3/4 cup firmly packed brown sugar
- 1 teaspoon vanilla
- 1 egg
- 3 cups oats
- 1 package (12 oz.) chocolate chips

Preheat oven to 375 degrees Fahrenheit. Beat together margarine, sugar, and brown sugar until creamy. Beat in egg and vanilla. Combine flour, baking soda, and salt. Gradually add to margarine mixture. Stir in oats and chocolate chips. Drop by rounded teaspoonfuls onto ungreased cookie sheets. Bake 8-11 minutes.☞

Recipe Number Four

- 2 3/4 cups all-purpose flour
- 2 teaspoons cream of tartar
- 1 teaspoon baking soda
- 1/2 teaspoon salt
- 1 cup shortening, margarine, or butter
- 1 1/2 cups sugar
- 2 eggs
- 3 tablespoons sugar
- 2 teaspoons cinnamon

Preheat oven to 350 degrees Fahrenheit. Beat together margarine and sugar. Beat in eggs. Combine flour, cream of tartar, baking soda, and salt. Gradually add to margarine mixture. Shape into balls the size of walnuts and roll into mixture of sugar and cinnamon. Bake 12-15 minutes.☞

Assignment**Questions for the Baker**

Name _____

Date _____

1. Which recipe (Number One, Two, Three, or Four) were you assigned? _____
2. a. What brand of flour did you use? _____
b. Was it bleached or unbleached? _____
3. a. Did you use shortening, margarine, or butter? _____
b. What brand? _____
c. Was the source animal or vegetable? _____
4. If you used vanilla, was it real or artificial? _____
5. Were the eggs small, medium, large, or extra large? _____
6. a. What brand of sugar did you use? _____
b. What, if anything, did the package say as to its degree of granulation? _____

7. If you used oats, chocolate chips or raisins, what brand and/or type did you use?
 - a. oats _____
 - b. chocolate chips _____
 - c. raisins _____
8. How long did you bake the cookies? _____
9. a. Did you vary the recipe in any way? _____
b. If yes, what variation did you make? _____

Discussion Questions**Research Group Analysis**

Group _____

Date _____

Lab supplies

-
- 1 plate per student (for Part One)
 - 1 plate per Research Group (for Part Two)
 - 1 gallon of milk, *optional*
 - 1 cup per student, *optional*

Procedure: Part One

Arrange your cookies on the plate provided by your teacher and put your plate of cookies with plates containing cookies baked from the same recipe as yours. Resist temptation and refrain from eating any cookies until you are otherwise instructed. Working in your Research Group, answer the questions in Part One and have one person from your group record your answers. Wait until all groups have answered the questions in Part One before going on to the questions in Part Two.

1. Do all the cookies on any given plate come from the same recipe? _____

2. Upon close examination, do all the cookies on any given plate look identical? _____

3. What similarities, if any, do you observe? _____

4. What differences, if any, do you observe? _____

5. Of any group of plates containing cookies from the same recipe, are the cookies identical from plate to plate? _____

6. What similarities, if any, do you observe? _____

7. What differences, if any, do you observe? _____

Procedure: Part Two

Each Research Group should obtain an empty plate. Place one cookie from every one of the plates on the Research Group's plate. Find a place in the room where you can continue to make cookie observations. Make no taste observations yet! Working in your Research Group, answer the questions in Part Two. Have one person from the Research Group record your answers.

1. What are possible reasons why all the cookies baked by the same individual might not be identical? _____

2. What are possible reasons why two batches of cookies baked by different individuals, using the same recipe, might not be identical? _____

3. Is there more than one recipe in existence for chocolate chip cookies? Why or why not? _____

4. Using the cookies as examples, can you always tell by looking at a group of different organisms as to which had the most similar "recipes"? Explain your answer. _____

5. a. Why isn't there only one recipe for cookies? _____

b. How might recipes come to change from one generation of bakers to the next? _____

c. Would any change in a recipe be as "fit" or beneficial as any other and what might determine its "fitness." Give reasons for your answer. _____

6. a. Can you think of cookies that seem to be specific to one ethnic group or geographic location? If yes, give an example. _____

b. Why might this be? _____

7. a. If you were asked to divide these four representatives of the cookie species on the plate into three groups, such as we divide species into varieties or breeds, what would those groups be?

b. What was your rationale for grouping them the way that you did? _____

8. Which recipe was most different from the others? What made it seem different? _____

Procedure: Part Three

When all Research Groups have finished the questions, get back together as a class to discuss your thoughts. During this discussion, you may begin an in-depth, enzymatic analysis of the cookies on your plate.