The Genetics of Parenthood

Standard Course of Study Goals and Objectives

Goal 1: Learner will develop abilities necessary to do and understand scientific inquiry.
  1.03: Formulate and revise scientific explanations and models of biological phenomena using logic and evidence.

Goal 3: Learner will develop an understanding of the continuity of life and the changes of organisms over time.
  3.03: Interpret and predict patterns of inheritance

Introduction to the Teacher

This is a simulation that easily captures student interest, and can be varied to meet different ability levels. Making the assumption that the P (parental) generation is heterozygous at all loci and that independent assortment occurs (no linkages), students flip coins to determine which allele they will pass on to the F_1 generation, and draw the resulting child's face. Emphasize the variation that occurs, reminding the students that all of these children are genetic siblings since all parents have identical genotypes.

Several inheritance patterns are represented in this simulation, and it is important to review these with the students beforehand. *Inheritance of the traits used in this simulation has been simplified to serve as a model*. Actual inheritance is far more complex; students may need to be reminded about this in case they get overly concerned about their own traits.

- **Dominant**: allele which masks the expression of another; represented by capital letters (R, V)
- **Recessive**: allele which is expressed only if both parents contribute it; represented by small letters (r, v)
- **Incomplete dominance**: phenotype of the heterozygote is an intermediate form; represented by capital letters and subscripts (C_1, C_2); an example is red color tints in the hair
- **Polygenic**: several genes contribute to the overall phenotype; an example is skin color
- **Sex-linked**: commonly applied to genes on the X chromosome, the more current term is X-linked; genes on the Y chromosome are **holandric** genes; no examples in this activity
- **Epistasis**: one gene masking the effects of another; an example is hair color to red color tints

After students have completed their individual data sheets, they need to collect class data for at least traits # 2 and trait # 8 in order to answer the analysis questions. This is a good time for class discussion of the probability of individuals sharing multiple traits.

Additional Activity Ideas

1. Have each "parent" draw the child's face. Then compare the "mother's" and the "father's" perception of characteristics.

2. Do the lab twice, comparing the genotypes and phenotypes of the resulting siblings.

3. "Marry" the children off, to produce an F_2 generation (grandchildren).

The Genetics of Parenthood

Purpose

To model how different combinations of genes inherited by offspring can produce tremendous variations in appearance.

Materials

- 2 coins (preferably different kinds to keep track of mother/father contribution)
- The Genetics of Parenthood Reference Sheets (attached)
- The Genetics of Parenthood Data Sheets (attached)
- drawing paper or white boards
- pens/crayons (Crayola has a "My World Colors" set for various skin/eye colors)

Introduction

Why do people, even closely related people, look slightly different from each other? The reason for these differences in physical characteristics (called **phenotype**) is the different combination of **genes** possessed by each individual.

To illustrate the tremendous variety possible when you begin to combine genes, you and a classmate will establish the genotypes for a potential offspring. Your baby will receive a random combination of genes that each of you, as genetic parents, will contribute. Each normal human being has 46 chromosomes (23 pairs—**diploid**) in each body cell. In forming the gametes (egg or sperm), one of each chromosome pair will be given, so these cells have only 23 single chromosomes (**haploid**). In this way, you contribute half of the genetic information (**genotype**) for the child; your partner will contribute the other half.

Because we don't know your real genotype, we'll assume that you and your partner are **heterozygous** for every facial trait. Which one of the two available alleles you contribute to your baby is random, like flipping a coin. In this lab, there are 36 gene pairs and 30 traits, but in reality there are thousands of different gene pairs, and so there are billions of possible gene combinations!

Procedure

Record all your work on the data sheet.

1. Determine your baby's gender. Remember, this is determined entirely by the father. The mother always contributes an X chromosome to the child.

   Heads = X chromosome, so the child is a girl
   Tails = Y chromosome, so the child is a boy

2. Name the child.

3. Determine the child's facial characteristics by having each parent flip a coin.

   Heads = child will inherit the first allele (i.e., B or N_1) in a pair
   Tails = child will inherit the second allele (i.e., b or N_2) in a pair

4. On the data sheet, circle the allele that the parent will pass on to the child and write the child's genotype.

5. Using the information in the reference sheets, look up and record the child's phenotype and draw that section of the face where indicated on the data sheet.

6. Some traits follow special conditions, which are explained in the reference sheets.

7. When the data sheet is completed, draw your child's portrait as he/she would look as a teenager. You must include the traits as determined by the coin tossing. Write your child's full name on the portrait.

The Genetics of Parenthood
Reference Sheets

1. **FACE SHAPE**:

Round (AA, Aa) Square (aa)

1.

2.

3.
    a.
    b.
    c.
    d.
    e.

4.
    a.
    b.

5.