Why are my eyes Brown?

Supplies needed (for a class of 32 students):

1. 1 Human Heredity Made Easy Kit
2. 32 pencils
3. colored pencils (optional)
4. 1 penny and 1 dime for each team of girls
5. 1 plastic cup for each team of girls
6. 32 copies of Student worksheet for Lesson #1
7. 32 copies of Student worksheet for Lesson #2 (2 pages)
8. 32 copies of Student worksheet for Lesson #3 (3 pages)

A. Introduction

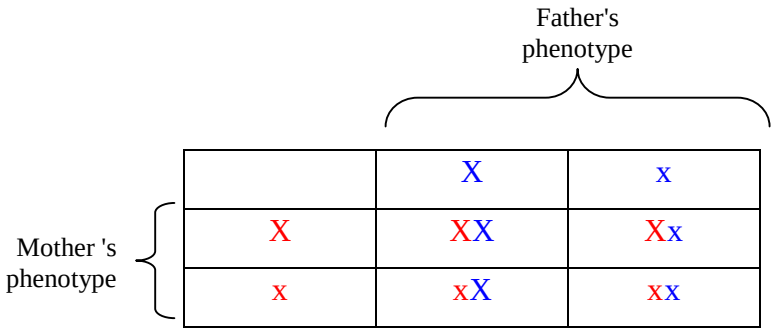
The basic laws Mendel discovered explain the basic inheritance in all living things. Pairs of simple traits, which we will concentrate on in this two-week lab, operate according to these laws. They are called **alleles** - traits for which two or more possibilities exist, one for which only may be expressed in a single individual. (see accompanying chart for a list of some of the simple Mendelian traits in humans)

In humans, one allele is inherited from ones biological father and one allele from ones biological mother for each genetic trait. This pair of alleles can be **dominant**, **recessive**, or **hybrid**. The dominant and recessive conditions are called pure or **homozygous** since both genes present are

identical. The hybrid condition possesses one of each gene type, and is called **heterozygous**. The genetic structure is called the **genotype**.

Although the genotype of an individual may differ from another's, their outward appearance for a particular trait may be identical. The outward appearance is called the **phenotype**. Take for example someone who inherits **R** (can roll tongue) from their mother and **r** (cannot roll tongue) from their father. Their genotype is **Rr**. Another individual inherits an **R** from both their mother and father. This individuals genotype is **RR**. Since the ability to roll your tongue is dominant, both the **Rr** and **RR** individuals will be able to roll their tongues. Hence, their phenotype is **R**.

The laws of inheritance are inherently the laws of chance. In a hybrid x cross, (the case where the mother and father are both heterozygous for a given trait), every offspring has a 50:50 chance of inheriting the dominant or recessive gene. A common way of illustrating this is with a **Punnett Square**:



The offspring in this example have a 50% change of being heterozygous for the X trait and 25% chance of being homozygous for the recessive x and 25% chance of 25% of being homozygous for the dominant X. Notice that the offspring have a 75% change of having the X phenotype.

Note all traits are simple Mendelian types. Many traits demonstrate incomplete dominance, where no gene is expressed over the others. Traits will be blended together to form an intermediate trait. An example of this is hair color. The combination of a brown-haired gene and a blonde gene will

most likely produce light brown hair. Other traits, such as skin color, are determined by multiple genes.

One special form of linkage affects inheritance in a very visible fashion. Certain genes are located on the chromosomes that determine sex. Traits that do, such as color-blindness, appear primarily in males. Hemophilia is another example. In each of these **sex-linked traits**, the recessive gene is carried on the X chromosome. A female is XX and a male is genetically XY. Thus, a male only has one X chromosome and if it carries a gene for color blindness or hemophilia, then he will exhibit that trait. However, for a female, there is a second X chromosome. For her to exhibit such a trait there must be the much rarer occurrence of the recessive gene present on both chromosomes.

Demonstration: Inheritance of dominant and recessive traits.

We will study human heredity using the family tree (FT) board. Scientists have developed a standard notation that is used on this board for discussing heredity. The squares on this board represent males and the circles represent females. A horizontal line between male and female indicates marriage. A vertical line indicates their descendants. When there are more than one descendent it is shown as given in line F2 on the board.

As you look at the FT board, the top row makred P1 represents two couples whom we call parents. Their offspring are labelled F1. The four descendants of these two are labelled F2. These are the grandchildren of the P1 generation. The F2 generation shows four offspring. It represents a 25% probability that the F1 parents can have a child with the traits being studied. (These correspond to the four entries in the Punnett square discussed above.)

Genes, in this kit, are represented by plastic parts illustrating various facial traits. Each part shows the trait which is the effect of the particular gene. (The phenotype is shown on the board and not the genotype.)

Preparation

On a small pallet, place 10 "brown eyes", 10 "blues" and 4 "H" labels.

Activity

Have the students do these activities along with you using their worksheets and colored pencils.

Line P1 on the Family Tree board represents the parents. Place two brown-eye traits into each male face along the P1 line. These male parents are both PURE brown in eye color. (Both genes in the pair are for brown eyes.)

Next, place two blue-eye traits onto each female face along P1. These female parents are both PURE blue in eye color. (Both genes in the pair are for blue eyes.)

Now each couple has one child. Each parent contributes one gene for eye color to his or her F1 child. Remove a gene from each parent (P1) and place it onto the face of its offspring. (Place another gene similar to the one just removed onto the parent since each gene occurs in pairs.)

Discussion

The transparencies are made to show that the effect of the gene for brown eyes hides the effect for the gene for blue eyes. The trait that shows, in this case brown eyes, is called Dominant. The hidden trait is called recessive.

The F1 children are all brown-eyed. They are called hybrid brown because they have one brown-eyed gene and one blue-eyed gene. Although their brown eyes may be the same in appearance as their P1 fathers, their genetic makeup is different. Label all hybrids with an "H"

Can the F2 children have blue eyes? Will they all be brown-eyed?

Activity

Place one additional brown and one blue onto each F1 parent. (This will give them enough genes to pass on to the next generation.) Now make the four possible offspring. Discuss the results. What are their eye colors? (3 brown, 1 blue) How many brown-eyed? (3) How many blue eyed? (1) How many hybrids? (2) Is their an equal chance to receive either gene? (yes) If these parents had four children, would they necessarily produce one blue-eyed child? (NO). (Lesson #2 will help the girls understand this.)

Activity

Proceed with **lesson #2**, Laws of chance. Tie the girls observations to the F2 offspring in the first lesson.

Lesson #3 - teacher's guide gives the directions. The P1 line should show the first set of parents to be father, pure brown (BB), mother, pure blue

(bb). The mother and father for the second set of parents should both be pure blue. This is the same as saying BB x bb and bb x bb. In this notation, males are always given to the left of the 'x' and females to the right. The uppercase letters (B) indicate a dominant trait. The lower case letters (b) indicate a recessive trait.

Have the students guess what the possibilities are for F1 and F2. Put the appropriate eyes on the board. The students should put the results on their worksheets.

There are 3 cases (2,3, & 4) in this lesson. Do as many as time permits.

Next week we will generalize what has been learned to other traits.