



Determination of Genotypes from Phenotypes in Humans

An organism can be thought of as a large collection of phenotypes. A phenotype is the appearance of a trait and is determined by pairs of genes. The alleles of those genes represent the genotype for the trait. If you were told a large enough number of phenotypic traits that belonged to another person, you would be able to recognize that person.

In this Exploration, you will determine some of your own phenotypic traits. From these, you will be able to determine what your genotypes are for some of the traits. If a trait is dominant and you possess that trait, you will not be able to determine your exact genotype because you could be either homozygous or heterozygous for the gene that controls the trait. However, if a trait is determined by incomplete dominance or codominance, you can tell what your genotype is. Genotypes of recessive traits also can be identified. By comparing your genotypes and phenotypes with those of other people in your class, you will see that you are a unique individual. Given the almost limitless number of gene combinations, it is almost impossible that anyone would have all the same traits as you.

OBJECTIVES

- Determine your phenotype for ten different traits.
- Determine your possible genotypes for the ten different traits.
- Compare your phenotypes and genotypes with those of other students in the class.
- Evaluate your uniqueness as an individual.

PROCEDURE

1. Obtain one piece each of PTC paper and untreated taste paper from the teacher. First, place the untreated taste paper on your wet tongue to see how it tastes. Then dispose of it in the wastebasket, and place the PTC paper on your wet tongue to see if you can taste phenylthiocarbamide—PTC.
2. PTC is quite bitter and you will notice readily whether or not you have the ability to taste this chemical. If you can taste PTC, enter “taster” in the proper place in the “Your Phenotype” column in Table 1. If you cannot taste the chemical, enter “nontaster” in the table. Discard the taste paper in the wastebasket.
3. Now that you have determined your phenotype, enter in the column marked “Your Possible Genotypes” what your genotype could be. Tasters are either TT or Tt . Nontasters are tt .

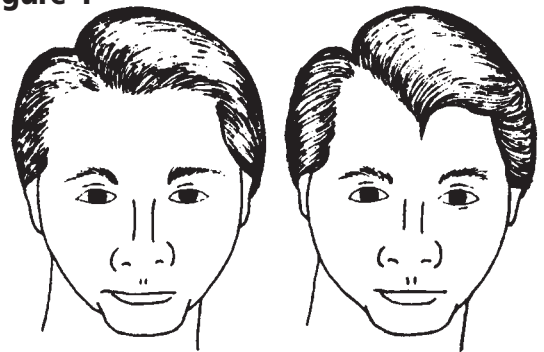
MATERIALS



PTC taste paper
untreated taste paper
mirror
laboratory apron
goggles

4. For each of the following traits, observe and record your phenotype in the table. Then record your possible genotypes.
 - a. **hairline**—The widow’s peak hairline comes to a point in the center of the forehead (WW or Ww). Individuals that lack the trait are ww .

Figure 1



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PROCEDURE continued

- b. eye shape**—Almond-shaped eyes (AA or Aa) are dominant to round eyes (aa).

Figure 2



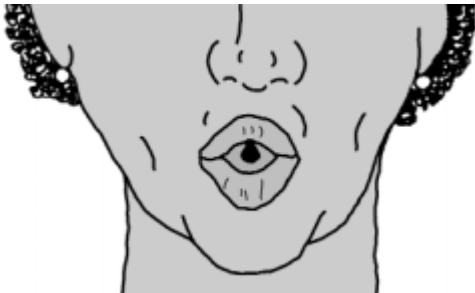
- c. eyelash length**—Long eyelashes (EE or Ee) are dominant to short eyelashes (ee).

Figure 3



- d. tongue rolling**—The ability to roll the tongue (CC or Cc) is dominant to the lack of this ability (cc).

Figure 4



- e. thumb**—A thumb tip that bends backward more than 30 degrees (hitchhiker's thumb) is dominant (BB or Bb) to a straight thumb (bb).

Figure 5



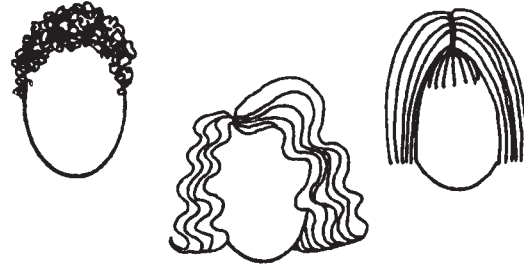
- f. lip thickness**—Thick lips (LL or Ll) are dominant to thin lips (ll).

Figure 6



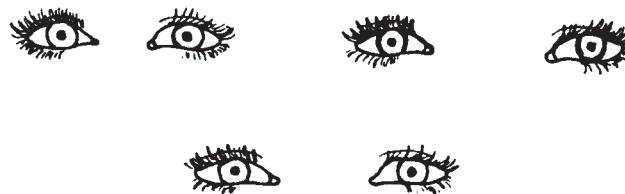
- g. hair texture**—Curly hair (HH) is incompletely dominant to straight hair (SS). Wavy hair is HS .

Figure 7



- h. inter-eye distance**—The distance between the eyes is an example of incomplete dominance. Close-set eyes are DD , eyes set far apart are FF , and medium-set eyes are DF .

Figure 8



- i. lip protrusion**—Protruding lips (PP) are incompletely dominant to nonprotruding lips (NN). Slightly protruding lips are PN .

Figure 9



Lab 12-1

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DATA AND OBSERVATIONS

Table 1

Human Phenotypes and Genotypes					
	Traits			Your phenotype	Your possible genotypes
	Dominant	Recessive			
PTC taste	Taster	Nontaster			
Hairline	Widow's peak	Straight line			
Eye shape	Almond	Round			
Eyelash length	Long	Short			
Tongue rolling	Can roll	Unable to roll			
Thumb	Hitchhiker's thumb	Straight thumb			
Lip thickness	Thick	Thin			
Hair texture	Curly	Wavy	Straight		
Inter-eye distance	Close together	Medium distance	Far apart		
Lip protrusion	Protruding	Slightly protruding	Not protruding		

ANALYSIS

1. Which traits do you have that are dominant?

2. Which traits do you have that are recessive?

3. Which of your traits are governed by incomplete dominance?

4. Which of your traits do you share with one or more of your classmates?

Determination of Genotypes from Phenotypes in Humans**ANALYSIS continued**

5. Which of your traits are unique to you?

6. If you and a particular classmate shared all of the same traits examined in this Exploration, what traits could you describe to prove your uniqueness?

7. What determines your traits?

8. How can a person's genotype for a trait be determined from his or her phenotype for the trait?

9. Why was untreated paper used in the PTC taste test?

FURTHER EXPLORATIONS

1. Books on human genetics from the library or the teacher will discuss many other human traits. Identify some other traits that you or your classmates have and try to determine the genotypes that cause them.
2. Calculate the percentage of the class that has each phenotype and compare these figures with national averages. Suggest reasons why your class might differ from the national percentages of some phenotypes.

12-1 EXPLORATION

Determination of Genotypes from Phenotypes in Humans

Objectives

- Determine your phenotype for ten different traits.
- Determine your possible genotypes for the ten different traits.
- Compare your phenotypes and genotypes with those of other students in the class.
- Evaluate your uniqueness as an individual.

Process Skills

observe, classify, infer, communicate

Time Allotment

1 class period

Materials

PTC taste paper (30 strips)
 untreated taste paper (30 strips)
 mirrors (30)
 laboratory aprons (30)
 goggles (30)

Preparation

- It is easier to order PTC taste papers from biological supply houses than to make them yourself. The papers can be made by soaking strips of paper in a 1% solution of phenylthiocarbamide and allowing the papers to dry.

Teaching the Lab

Students should work individually.

- Review with students the differences between simple Mendelian inheritance and incomplete dominance.
- Go over each trait with the class before students begin this Exploration.
- The genotypes of incompletely dominant traits are represented by capital letters with a different letter representing each allele. The use of this convention reminds the student that in incomplete dominance, neither gene is dominant to the other.

Data and Observations

Table 1 Answers will vary.

Analysis

1. Students' answers will vary but should be the same as in their data tables.
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4. Answers will vary. Students should note that they share some, but not all, traits with their classmates.
5. Answers will vary. Students should note that they share some, but not all, traits with their classmates.
6. If two classmates shared all of the same traits in the list, they could prove uniqueness by listing other traits that are not shared. These will vary.
7. The genes inherited from parents determine the traits of the offspring.
8. Genotypes of recessive traits can be determined because a person must have two recessive alleles for the trait to express that trait. Genotypes can also be determined for incompletely dominant and codominant phenotypes because there is a different genotype for each phenotype. Genotypes cannot be determined for dominant traits because the homozygous dominant and heterozygous genotypes appear as the same phenotypic trait.
9. The untreated paper was used as a control to indicate to the taster that the paper itself did not taste bitter.