Name _____ Date _____

Determination of Genotypes from Phenotypes in Humans 9–1

LAB

EXPLORATION

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 pairs of 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. However, if a trait is determined by incomplete dominance, you can tell if you are homozygous or heterozygous. Genotypes of recessive traits can be identified. By comparing your genotypes and phenotypes with other people in your class, you will see why 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 nine different characteristics.
- Determine your possible genotypes for the nine different characteristics.
- Compare your phenotypes and genotypes with those of other students in the class.
- Evaluate your uniqueness as an individual.

MATERIALS

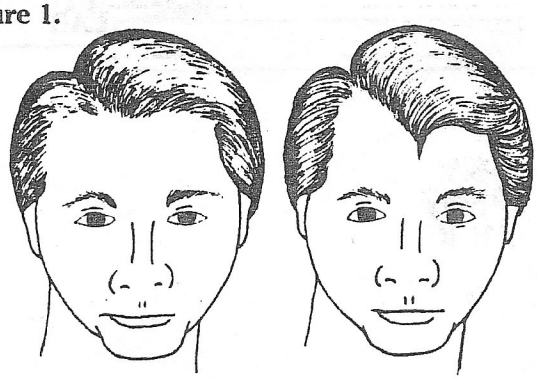
PTC taste paper
untreated taste paper
mirror

PROCEDURE

1. Obtain one piece each of PTC paper and untreated taste paper from your teacher. First, place the untreated 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 the table. 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**.
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.

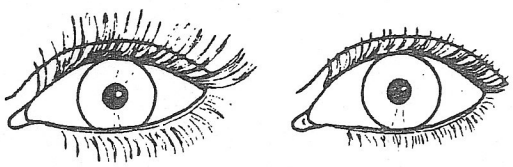


b. **eye shape**—Almond-shaped eyes (**AA** or **Aa**) are dominant to round eyes (**aa**).

Figure 2.

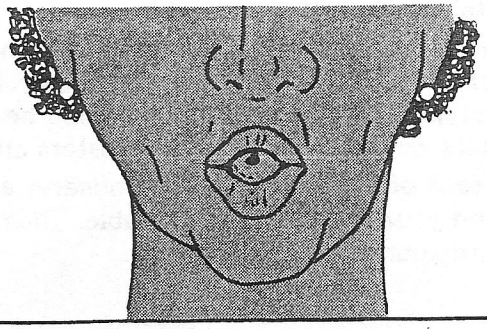
c. **eyelash length**—Long eyelashes (**EE** or **Ee**) are dominant to short eyelashes (**ee**).

Figure 3.



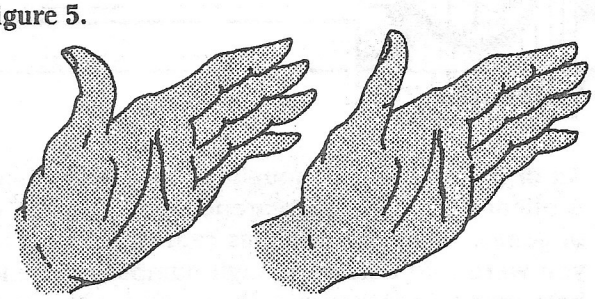
d. **tongue rolling**—The ability to roll the tongue (**CC** or **Cc**) is dominant to the lack of this ability (**cc**).

Figure 4.



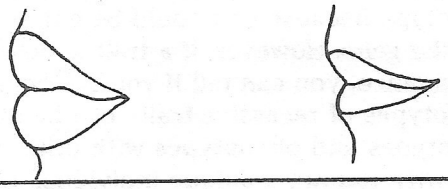
e. **thumb**—One whose thumb tip bends backward more than 30 degrees (hitch-hiker's thumb) is dominant (**BB** or **Bb**) to a straight thumb (**bb**).

Figure 5.



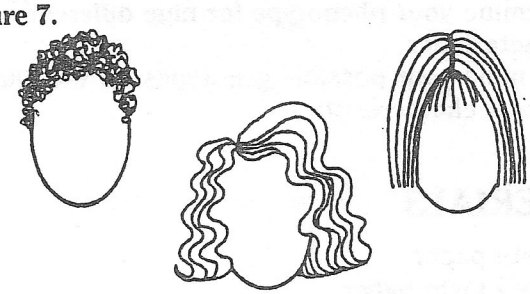
f. **lip thickness**—Thick lips (**LL** or **Ll**) are dominant to thin lips (**ll**).

Figure 6.



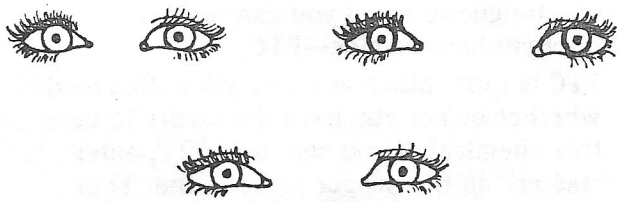
g. **hair texture**—Curly hair (**HH**) is incompletely dominant to straight hair (**SS**). Those that have wavy hair are **HS**.

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**.

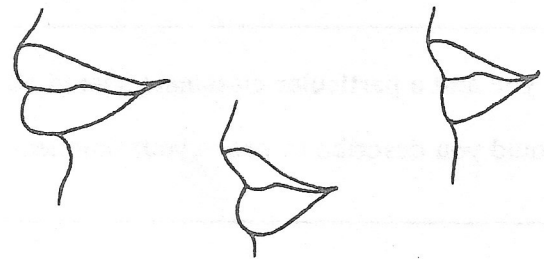
Figure 8.



Name _____ Date _____

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

Figure 9.



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 dexterity	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? _____

_____

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. With knowledge of the phenotype of a human, how can a person's genotype be determined? _____

_____

_____

_____

_____

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

_____

FURTHER EXPLORATIONS

1. Books from the library or your teacher on human genetics will discuss many other human characteristics. Identify some other characteristics 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.

Determination of Allele Frequencies from Human Phenotypes (Lab 9-1)

1) Determine the percentage (as a decimal) of individuals from class that are homozygous recessive for the trait.

2) Determine the frequency of the recessive allele (square root from above)

3) Calculate the frequency of the dominant allele by the following equation:
(Dominant allele frequency = 1 - recessive allele frequency)

Answer Key

Trait	Homozygous recessive individuals	Total individuals sampled	Percentage homozygous recessive	Recessive allele frequency	Dominant allele frequency
PTC	9	26	9/26 ≈ 0.35	√.35 ≈ 0.59	0.41
Hairline	22	26	22/26 ≈ 0.85	√0.85 ≈ 0.92	0.08
Eye Shape	8	26	0.31	√.31 ≈ 0.56	0.44
Eyelash length	4	26	0.15	√.15 ≈ 0.39	0.61
Tongue dexterity	2	26	0.08	√.08 ≈ 0.28	0.72
Thumb	23	26	0.88	√.88 ≈ 0.94	0.06
Lip Thickness	15	26	0.58	√.58 ≈ 0.76	0.24