

Constructing a Human Pedigree

Pre-Lab Discussion

Human traits are often difficult to study for several reasons. Unlike some organisms, which produce large numbers of offspring very quickly, humans reproduce slowly and produce few offspring at one time. Thus human traits must be studied through population sampling and pedigree analysis. A *pedigree* is a diagram that shows the phenotype of a particular genetic trait in a family from one generation to the next. Genotypes for individuals in a pedigree often can be determined with an understanding of inheritance and probability.

In this investigation, you will use both population sampling and pedigree analysis to observe human traits.

Problem

How can pedigree analysis help in the study of human traits?

Materials (per student)

No special materials are needed.

Procedure

Part A. Interpreting a Pedigree Chart

- Figure 1 is a pedigree, or a diagram of a family's pattern of inheritance for a specific trait.

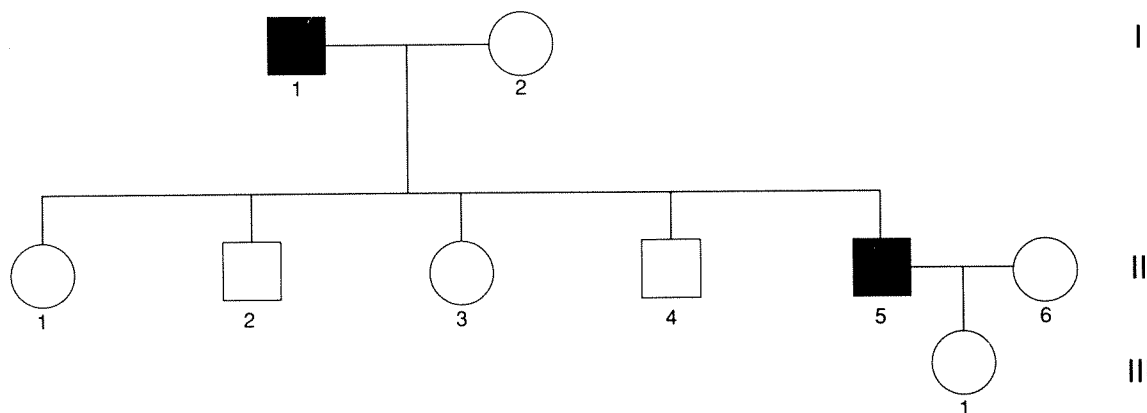


Figure 1

2. Notice that in a pedigree, each person is represented by an Arabic number and each generation is represented by a Roman numeral. In this way, each person can be identified by a generation numeral and an individual number. Males are represented by squares and females by circles. Unshaded symbols (squares or circles) indicate people who are homozygous or heterozygous for the dominant trait. Shaded symbols indicate people who are homozygous for the recessive trait.
3. In Figure 1, I-1 and I-2 are the parents. The horizontal line that connects them is called a marriage line. The vertical line that extends down from the marriage line connects the children to the parents. Children are listed in order of their births from left to right. In other words, the oldest child is always placed on the extreme left. In this pedigree, persons II-1, II-2, II-3, II-4, and II-5 are the children of persons I-1 and I-2.
4. The trait being analyzed in Figure 1 is ear-lobe shape. There are two general ear-lobe shapes, free lobes and attached lobes. See Figure 2. The gene responsible for free ear lobes, represented by the capital letter E, is dominant over the gene for attached ear lobes, represented by the lowercase letter e. People with attached ear lobes are homozygous for the recessive trait and are represented as ee. In Figure 1, I-1 and II-5 are homozygous recessive (ee) and have attached ear lobes. The people represented by the unshaded symbols have two possible genotypes: EE or Ee.

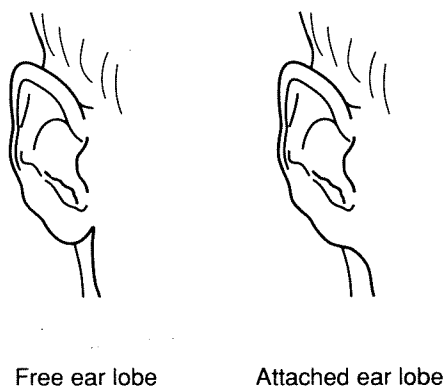


Figure 2

5. Use Figure 1 to complete questions 1 through 8 in Observations.

Part B. Constructing a Family Pedigree

1. In the space provided in Observations, draw the outline of a pedigree of your family or a family who lives near you. In the pedigree, include any grandparents, aunts, uncles, cousins, nieces, or nephews that live nearby. Number the generations and individuals.
2. The ability of a person to roll his or her tongue is the result of the dominant allele R. People who cannot roll their tongues have the genotype rr. People who can roll their tongues have the genotype RR or Rr. If you are developing a pedigree for your own family, determine if you can roll your tongue. See Figure 3.



Tongue roller



Non-tongue roller

Figure 3

3. If you cannot roll your tongue, enter the genotype rr in the space below your symbol on the pedigree.
4. If you can roll your tongue, enter the genotype $R_$ for the presence of the dominant gene in the space below your symbol on the pedigree.
5. If you are constructing a pedigree for your own family, survey additional members of your family for their ability to roll their tongue. If you are constructing a pedigree for another family, survey as many members of that family as possible.
6. Record the results of family members you tested in your pedigree.

Observations

1. What is the genotype of I-2? Explain your answer. _____

2. What are the genotypes of II-1, II-2, II-3, and II-4? Explain your answer.

3. What are the possible genotypes for II-6? Explain your answer. _____

4. If II-6 is EE, what is the genotype of her child with II-5? _____

5. What sex is the oldest child in generation II? _____

6. Who is the youngest child in generation II? _____

7. Who is the daughter-in-law in this family? _____

8. How many generations are represented in this pedigree? _____

Use this space to construct the pedigree for the family you have chosen to study. Correctly number each generation and person. Shade in the symbols for those people who are homozygous recessive. Below the symbol for each person, write as much of the person's genotype as possible.

Analysis and Conclusions

1. Would you expect the other students in your class to have tongue-rolling pedigrees that are identical to yours? Explain your answer. _____

2. Explain why you are not always able to determine the exact genotype for a trait of a person when you construct a pedigree. _____

3. If two parents are unable to roll their tongues, is it likely that they will have children who will be able to roll their tongues? Explain your answer. _____

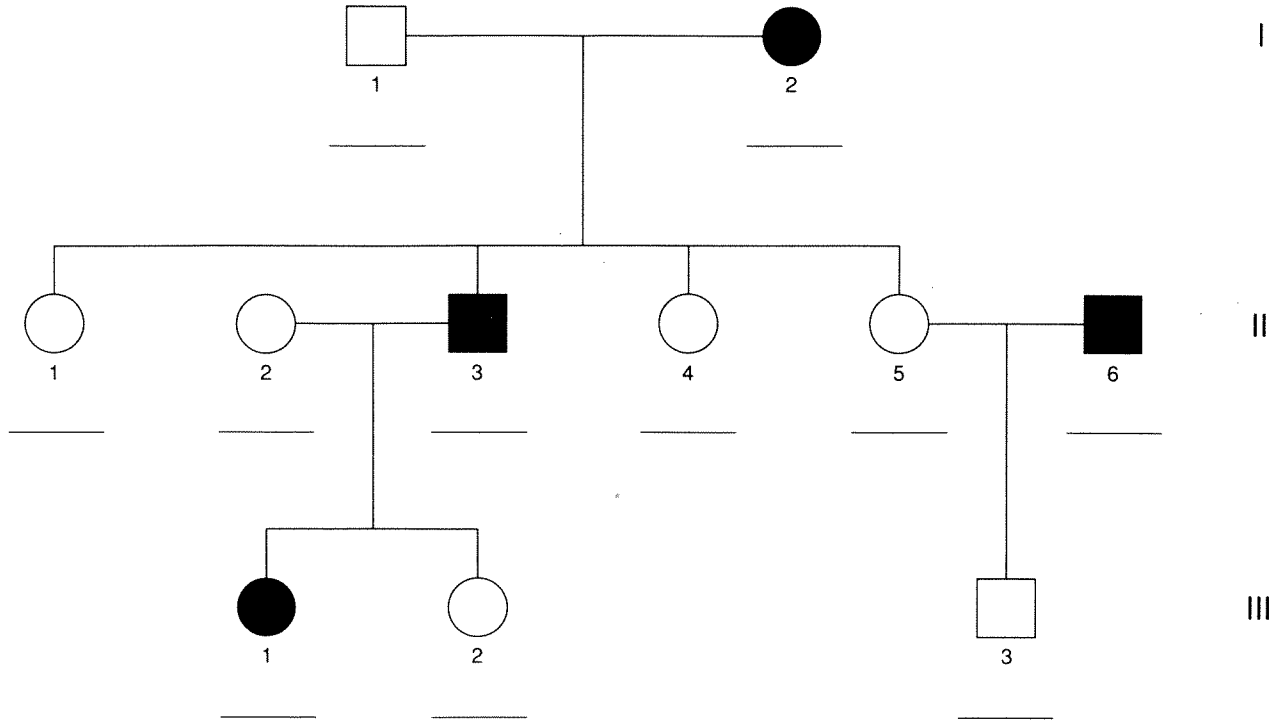
Critical Thinking and Application

1. Can the actual traits of an offspring be determined by knowing the traits of the parents? Explain your answer. _____

2. A woman received the genes aBcD from her mother and AbCd from her father. Which of the following gene combinations could be present in her gametes: ABCD, abcd, ABCDD, aBccD, ABcd, AaBb? Explain your answer. _____

3. If a man who has long eyelashes (LL) marries a woman who has long eyelashes (Ll), what are the possible genotypes and phenotypes of their children? _____

4. Complete the pedigree in the figure below. In the spaces below each symbol, write as much of the genotype of each individual as can be determined from the information provided. Assume the shaded symbols represent the homozygous recessive genotype rr .



Going Further

Design another pedigree for the family you used in Part B showing any of the following traits: hair on middle joint of fingers, straight little finger, cleft in chin, direction of hair whorl. Determine if each of these traits is dominant or recessive. Apply all appropriate symbols and labels with the possible genotypes of each person. Compare the different pedigrees you have constructed. What are the similarities? Differences?