NATURAL SCIENCE 162

Spring 2007

GENETICS STUDY

The purpose of this study is to become familiar with some common genetically determined human characteristics.

1. Learn some of the characteristics. Then observe these characteristics in yourself and your parents, spouse, children, brothers, sisters, etc.

2. Fill out the chart.

3. Make a genealogical chart for at least two generations, preferable, three, for two characteristics.

4. Do genetic problems.

GENETIC DETERMINATION OF SELECTED HUMAN CHARACTERISTICS

Many human traits are determined by a single pair of alleles easily identifiable by observation. For each of the characteristics described here, determine (as best you can) both your own phenotype and genotype, and record this information on Table 1. Since it is impossible to know whether your are homozygous or heterozygous for a trait when you exhibit its dominant expression, you are to record your genotype as A-- (or B--, and so on, depending on the letter used to indicate the alleles) in such cases it you exhibit the recessive trait, you are homozygous for the recessive allele and should record it accordingly as aa (bb, cc, and so on). When you have completed your observations, also record your data on the chart for tabulation of class results, on the chalkboard.

Tongue rolling: Extend your tongue and attempt to roll it into a U-shape longitudinally. People with this ability have the dominant allele for this trait. Use T for the dominant allele, and t for recessive allele (see figure).

Attached earlobes: Have your lab partner examine your earlobes. If no portion of the lobe hangs free inferior to its point of attachment to the head, you are homozygous recessive (ee) for attached earlobes. If part of the lobe hangs free below the point of attachment, you possess at least one dominant gene (E) (see figure).

Interlocking fingers: Clasp your hands together by interlocking your fingers. Now observe your clasped hands. Which thumb is uppermost? If the left thumb is uppermost, you possess a dominant allele (I) for this trait. If you clasped your right over your left thumb, you are illustrating the homozygous recessive (ii) phenotype.

PTC taste: Obtain a PTC taste strip. PTC or phenothiocarbamide is a harmless chemical that some people can taste and others find tasteless. Chew the strip. If it tastes slightly bitter, you are a "taster" and possess the dominant gene (P) for this trait. If you cannot taste anything, you are a non-taster and are homozygous recessive (pp) for the trait. Approximately 70% of the United States' population are tasters.

Sodium benzoate taste: Obtain a sodium benzoate taste strip and chew it. A different pair of alleles determines the ability to taste sodium benzoate (as opposed to PTC taste). If you can taste it, you have at least one of the dominant alleles (S). If not, you are homozygous recessive (ss) for the trait. Also record whether sodium benzoate tastes, salty, bitter, or sweet to you (if a taster). Even though PTC and sodium benzoate taste are inherited independently, they interact to determine a person’s taste sensations. Individuals who find PTC bitter and sodium benzoate salty tend to be devotees of sauerkraut, buttermilk, spinach, and other slightly bitter or salty foods.

Sex: The genotype XX determines the female phenotype, whereas XY determines the male phenotype.

Dimpled cheeks: The presence of dimples in one or both cheeks is due to a dominant gene (D). Absence of dimples indicates the homozygous recessive condition (dd) (see figure).

Widow's peak: A distinct downward V-shaped hairline at the middle of the forehead is referred to as a widow's peak. It is determined by a dominant allele (W), whereas the straight or continuous forehead hairline is determined by the homozygous recessive condition (ww).

Bent little finger: Examine your little finger on each hand. If its terminal phalanx angles toward the ring finger, you are dominant for this trait. If one or both terminal digits are essentially straight, you are homozygous recessive for the trait. Use L for the dominant allele and l for the recessive allele.

Double-jointed thumb: A dominant gene determines a condition of loose ligaments that allows one to throw the thumb out of joint. The homozygous recessive condition determines tight joints. Use J for the dominant allele and j for the recessive allele.

Mid-digital hair: Critically examine the dorsum of the middle segment (phalanx) of your fingers. If no hair is obvious, you are recessive (hh) for this condition. If hair is seen, you have the dominant gene (H) for this trait (which, however, is determined by multigene inheritance) (see figure).

Freckles: The appearance of freckles is a result of a dominant gene. Use F as the dominant allele and f as the recessive allele (see figure).

Blaze: A lock of hair different in color from the rest of the scalp hair is called a blaze; it is determined by a dominant gene. Use B for the dominant gene and b for the recessive gene.

Blood type: Inheritance of ABO blood type is based on the existence of 3 alleles designated as I^A, I^B, and i. Both I^A and I^B are dominant over i, but neither is dominant over each other. Thus the possession of I^A, and I^B will yield type AB blood, whereas the possession of the I^A and i alleles will yield A blood, and so on as explained in Exercise 29. There are four ABO blood groups or phenotypes, A, B, AB, and O, and their correlation to genotype is indicated as follows:

ABO blood group	**Genotype**
A	I^AI^A or I^Ai
B	I^BI^B or I^Bi
AB	I^AI^B
O	ii

Record of Human Genotype/Phenotype Genotype of

Characteristic	Phenotype your	Genotype your	Parent	Spouse	Child
Tongue rolling (T,t)					
Attached earlobes (E,e)					
Interlocking fingers (I,i)					
PTC taste (P,p)					
Sodium benzoate taste (S,s)					
Thiourea (U,u)					
Sex (X,Y)					
Dimples (D,d)					
Widow's peak (W,w)					
Bent little finger (L,l)					
Double-jointed thumb (J,j)					
Middigital hair (H,h)					
Freckles (F,f)					
Blaze (B,b)					
ABO blood type (I^A,I^B,i)					

Curly hair (C,c)					
Hair texture (X,x) coarse, fine					
Hair color (R,r) dark light					
Nose shape (N,n) convex, concave					
Eye color (A a) (blue) recessive					
Long palmar muscle (P,p)					
Right hands left hand (6, g)					
Space between front teeth (K,k)					
Select any two traits and draw a genealogical chart for at least two generations. = male O = female					

GENETICS PROBLEMS

1. In one of Mendel's studies he found that the gene for purple flowers was dominant over its allele for white flowers. Use a diagram to show a cross between a pure-line purple-flowered plant and a white-flowered plant. Use the correct letter symbols; show both genotype and phenotype for the first and second generations.

2. What results would have been expected if Mendel had crossed one of the F_1 hybrids of the above cross with a white-flowered plant? Use a diagram showing one generation only, - genotype and phenotype.

3. In Holstein cattle the spotting of the coat is due to a recessive gene, while a solid-colored coat is dominant. What types of offspring would you expect when two spotted animals are crossed? Use a diagram to justify your conclusion.

4. A man and his wife both have brown eyes (pigmented) but the wife bears a child with blue (unpigmented) eyes. Use a diagram, including genes, to explain how this result can legitimately appear.

5. An albino man marries a normally pigmented woman who had an albino mother. Show the types of children this couple may expect and the proportion of each.

6. Suppose you are a marriage counselor and a young woman comes to you for advice. She tells you that her brother has hemophilia, but both her parents are normal. She wishes to marry a man who had an uncle with hemophilia and wants to know the probability of the disease in possible children she may have. What would you tell her, and how would you explain your conclusions?

7. Three children are left orphans when their parents are killed in an automobile crash. The physician finds that the one boy of the three is color-blind, one girl is color-blind and the second girl has normal color vision. Show the genotype and phenotype of each parent.

8. A woman is color-blind and her husband is color-blind, yet they have four daughters with normal vision. Show the most likely explanation of these results.

9. Pseudohypertrophic muscular dystrophy is a recessive x-linked trait in man. A certain couple has five children, - three boys, aged 1, 3 and 10, and two girls, aged 5 and 7. The oldest boy shows the wasting away of the muscle characteristic of this disease. The parents ask what are the chances of the disease appearing in the other four children. What would you tell them and how would you explain it?

10. A man sues his wife for divorce on the grounds of infidelity. Both man and wife have normal eyes, but the woman bears a baby daughter with coloboma iridis, a fissure in the iris of the eye. This trait is known to be an x-linked recessive. If you were the man's lawyer, could you use this fact as evidence? If so, how would you present your case to the jury?

11. A woman who has normal vision marries a color-blind man and they have three daughters with normal vision and one color-blind son. One of the daughters has a color-blind son by a man with normal vision. What can we say about the genotype of the original mother and father?

12. A woman with type A blood marries a man with type B blood. They have a child with type O blood and another with type AB. Explain this in genetic terms.

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