

Laboratory 10

Human Genetics

Student Tip Sheet

Have you ever thought about why you have certain characteristics or why you are similar to a certain member of your family? Have you ever wondered what your children will look like? After your lab and class discussion on Mendelian Genetics some of those questions have probably been answered. This lab will put your genetic information to practical and personal use. Work with a partner and examine your human characteristics listed in your manual. Think about your family and perhaps discuss these physical characteristics over dinner. It is always interesting to compare and make note of each particular characteristic and note that each is genetically controlled.

In the introduction of Chapter 10, and in most texts, the genetic terminology again can be very confusing. For instance, the first sentence states that “A zygote receives 23 pairs of chromosomes when the gametes unite during fertilization.” A zygote does not receive 23 pairs, but rather “consists of” these pairs after fertilization. Therefore, this sentence could be more clearly stated as “A zygote *consists of* 23 pairs of chromosomes *after* the gametes unite during fertilization.” Don’t be confused by the inconsistent use of the terms “chromosome” and “pair,” just please read slowly and ask questions if you need clarification.

The Human Genome Project continues to be in the news. Perhaps one day all of the genes will be identified for the human being. The popular media has frequent articles to publicize the latest research to identify certain genes on a particular chromosome. Now that you can understand some of the technical terms read these articles carefully and make special note of any topic that interests you. Search the Internet for the very latest in research.

Genetics Problems

Many time students have trouble working genetics problems and simply need extra practice. Please see the following additional problems that have been very useful. The list begins with simple problems and continues with more challenging ones. Please also see that the answers are included. If you are having problems, choose one and try to solve it before looking at the answer. If you are correct, try a harder one, just for fun. If you miss it, ask your teacher for an explanation. Make certain that you consistently follow the same format for each problem. Always write down each fact as it is given in the problem and put these facts in the same order each time. Each problem will include all the facts that you need. The consistent method of using a similar pattern for each problem will prevent much confusion.

Additional Genetics Problems

Simple/Monohybrid

1. Short hair is dominant over long hair in guinea pigs. A short-haired guinea pig, one of whose parents was long-haired, was mated with a long-haired animal. What is the expected nature of their offspring?
2. In humans, brown eyes (B) are dominant over blue (b). A brown-eyed man marries a blue-eyed woman and they have eight children, all brown-eyed. What are the genotypes of all the individuals in the family?
3. In sheep, white is due to a dominant factor W; black is due to a recessive allele, w. A white ewe mated to a white ram produced a black lamb. (a) If they produce another offspring, could it be white? (b) If so, what are its chances of being white? (c) List the genotypes of all the animals mentioned here.
4. The polled or hornless condition in cattle (P) is dominant over the horned (p). A cross between homozygous polled and homozygous horned cattle would yield polled offspring. What would be the genotype and the phenotype found in the F₂ generation.
5. Brown color in mice is dominant over albinism. In a given cross between a brown mouse and an albino, six of the offspring were brown, five albino. What was the genotype of the brown parent?
6. In guinea pigs, the coat may be rough or smooth. Certain rough-coated guinea pigs when crossed with smooth-coated ones produced all rough-coated offspring. Other rough-coated guinea pigs when crossed with smooth-coated ones produced equal numbers of rough-coated and smooth-coated offspring. Smooth-coated guinea pigs crossed with each other always produced smooth-coated offspring. Explain these results.

Monohybrid / Incomplete / Codominance

7. In four o'clock flowers, red flower (R) is incompletely dominant over white (r), the heterozygous plants being pink-flowered. If a red-flowered four-o'clock plant is crossed with a white-flowered one, what will be the flower color of the F₁? Of the F₂?
8. In poultry, black and splashed-white are alleles, but neither is dominant. They blend, forming blue, the so-called "blue Andalusian." What kind of offspring would be produced, and what is the phenotypic ratio, if a blue Andalusian male bird is crossed with (a) a black female? (b) A blue female? (c) A splashed-white female?
9. In shorthorn cattle, when red coat color is crossed with white, F₁ are all roan, a blend between the two colors. Let R represent one factor, and r be its allele, neither being dominant, but acting in such a way that RR produces red, Rr produces roan, and rr produces white. Give the genotypes and the phenotypes (in ratios) of the F₂ generation. Starting with a roan bull and white cow, could one establish a true-breeding red herd? How?

Dihybrid

10. In rabbits, spotted coat (P) is dominant to solid color (p), and black (B) is dominant to brown (b). A homozygous solid brown rabbit is mated to a homozygous spotted black rabbit. What would be the appearance of their offspring? (F₁) Predict the F₂ generation.
11. In cats, the long hair of a Persian is recessive to short hair (H=short, h=long). Also the black and tan color of a Siamese is recessive to a pure black coat. If a heterozygous, short-haired black cat is mated to a pure black and tan, long-haired cat, what will be the phenotypes of their kittens?

Sex-linked

12. The factor for color blindness is recessive. X is a normal chromosome for normal vision. x is an X chromosome carrying a gene for color blindness. A woman of genotype XX would have normal vision. A woman with genotype xx would be color-blind. A man of genotype XY would have normal vision; a man of genotype xY would be color-blind. (a) Two normal-visioned parents produce a son who is color-blind. What are the genotypes of the parents? (b) A girl with normal vision whose father was color-blind marries a color-blind male. What will be the nature of their children with respect to color blindness?
13. Hemophilia (Bleeder's Disease) is a sex-linked characteristic in humans. Could a normal man and a woman who carried the gene for the disease, but did not have the disease, have a daughter with hemophilia? Why or why not?

Multiple Alleles

14. Mrs. Doe and Mrs. Roe had babies at the same hospital at the same time. Mrs. Doe took home a boy and named him Richard. Mrs. Roe took home a girl and named her Sally. However, she was sure she had a boy and brought suit against the hospital. Blood tests showed that Mr. Roe was type B, Mrs. Roe was type AB, Mr. Doe was type O and Mrs. Doe was type O. Sally was type O and Richard was type B. Had an exchange occurred?

Trihybrid

15. In peas, a tall plant (T) is dominant to dwarf (t), yellow color (Y) is dominant to green (y) and smooth seed (S) is dominant to wrinkled seed (s). What would be the genotypes and phenotypes of the following cross: TTYySs x Ttyyss?
16. In garden peas, a tall vine (T) is dominant over dwarf (t); green pods (G) over yellow (g); and round seed (R) over wrinkled seed (r). If a homozygous dwarf, green, wrinkled pea plant is crossed with a homozygous tall, yellow, homozygous round one, what will be the appearance of the F₁?

Answers to Additional Genetics Problems

1. _ homozygous
_ heterozygous
2. Dad = BB, Mom = bb, children = Bb
3. Male = Ww, Female = Ww, Offspring = WW, Ww, Ww, ww
4. Genotype = PP, Pp, pp Phenotype = 3 polled, 1 hornless
5. Bb
6. RR x rr, Rr x rr, rr x rr
7. F₁ = pink F₂ = red, white, pink
8. a. 1:1 b. 1:2:1 c. 1:1
9. RR, Rr, rr red, white, roan 1:2:1 Yes, use the roan offspring for breeding.
10. Spotted Black, Spotted Black, Spotted brown, solid Black, solid brown
11. short hair, black; short hair, black and tan; long hair, black; long hair, black and tan
12. a. Xx, XY b. 1:1 or 50% color-blind
13. No...must get one disease-carrying gene from the father
14. Yes
15. TTYySs, TtYySs = Tall Yellow Smooth
TTYyss, TtYyss = Tall Yellow wrinkled
TtyySs, TtyySs = Tall green Smooth
Ttssyy, Ttyyss = Tall green wrinkled
16. Tall Green Round