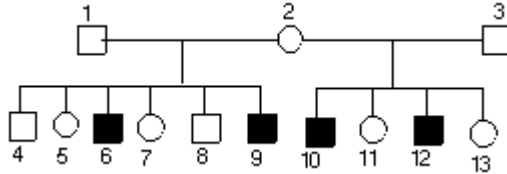
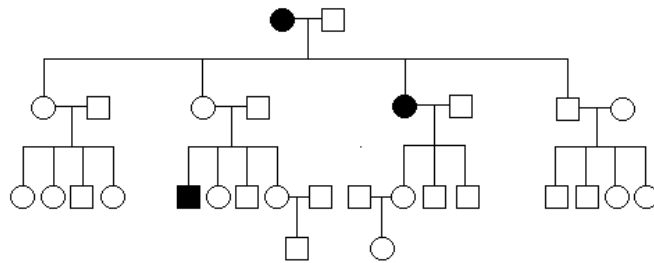


1. The ability to roll the tongue is dominant over the inability to do so in humans.
  - a. If two heterozygous tongue-rollers have children, what genotypes could their children have?
  - b. If a non-tongue-roller has children with a homozygous tongue-roller, what will their children's genotypes be?
2. In an alien species, eye colors can be black, white, or gray. A white-eyed mother and a black-eyed father have all gray-eyed children.
  - a. What genetic pattern is most likely demonstrated here?
  - b. A gray-eyed couple has two babies: one white-eyed and one black-eyed. Does this confirm or deny your answer to part A? If necessary, revise your hypothesis.
  - c. A gray-eyed alien and her black-eyed husband want a white-eyed baby. Is this possible?
3. A mother has blood type A and genotype  $I^A I^O$ . A father has blood type B and genotype  $I^B I^O$ . What blood types are possible for the offspring?
4. In pea plants, tallness is dominant over shortness and smooth seeds are dominant over wrinkled seeds. If two heterozygous tall plants which are heterozygous for smooth seeds are crossed, what are the genotypes and phenotypes of the offspring?
5. As a genetic counselor, you routinely advise couples about the possibility of genetic disease in their offspring based on their family histories. This morning you met with an engaged couple, both of whom are phenotypically normal. The man, however, has a brother who died of Duchenne-type muscular dystrophy. This is an X-linked condition that results in death before the age of 20. The allele responsible for the disease is recessive. His prospective bride, whose family has no history of the disease, is worried that the couple's sons or daughters might be afflicted.
  - a. How would you advise this couple?
  - b. The sister of this man is planning to marry his fiancé's brother. How would you advise this second couple?
6. Mr. Spock was the first officer of the starship *Enterprise* in the 1970s-era TV series called Star Trek. Mr. Spock's father came from the planet Vulcan and his mother from planet Earth. A Vulcan has pointed ears and a heart located on the right side of the chest. Mr. Spock has both of these traits, which are known to be determined by two different genes, with two alleles each. Suppose that Mr. Spock married an Earth woman and that they had many children. About half of their children look like Spock (pointed ears and right-sided heart) and about half look like their mother (rounded ears and left-sided heart).
  - a. What would Mendel predict the progeny phenotypes and ratios to be? Explain your answer using formal genetic terminology.
  - b. How do you explain the actual results?
7. In a particular dog, short hair is dominant over long, and dark is dominant over light. One dog is heterozygous for hair length and shows the recessive trait for hair color. Another dog is homozygous dominant for hair length and heterozygous for hair color. Identify the possible phenotypes of the offspring and give the number of each expected.

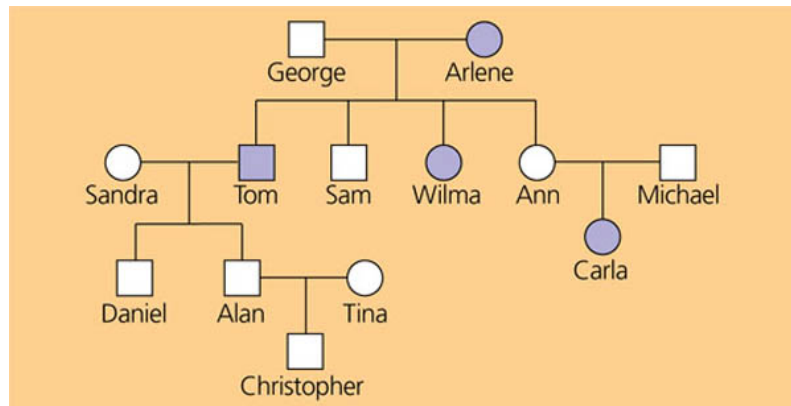
8. The allele that causes albinism (p) is recessive to the allele for normal pigmentation (P). A normal woman whose father is an albino marries an albino man whose parents are both normal. They have three children, two normal, one albino. Give the genotype for each individual.
9. What is the most likely explanation for the pattern of inheritance illustrated in the pedigree below?



10. What is the most likely explanation for the pattern of inheritance illustrated in the pedigree below?



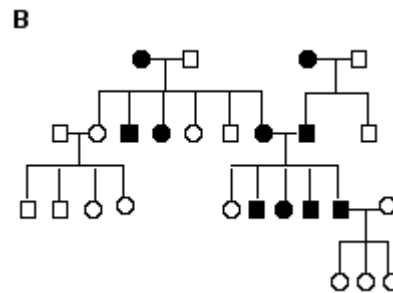
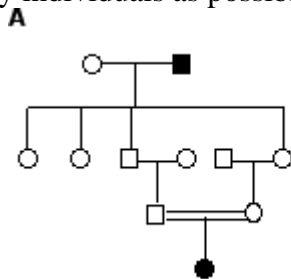
11. The pedigree below traces the inheritance of alkaptonuria, a biochemical disorder. Affected individuals, indicated here by the colored circles and squares, are unable to break down a substance called alkapton, which colors the urine and stains body tissues.
- Does alkaptonuria appear to be caused by a dominant allele or by a recessive allele?
  - Fill in the genotypes of the individuals whose genotypes can be deduced.
  - What genotypes are possible for each of the other individuals?



12. In tigers, a recessive allele causes an absence of fur pigmentation (a white tiger) and a cross-eyed condition. If two phenotypically normal tigers that are heterozygous at this locus are mated, what percentage of their offspring will be cross-eyed? What percentage will be white?

13. Four genes (A, B, C, and D) are on the same chromosome. The recombination frequencies are as follows: A-B: 19%; B-C: 14%; A-C: 5%; B-D: 2%; A-D: 21%; C-D: 16%. Based on this information, which sequence of genes is correct?
14. If a mother is heterozygous for a recessive sex-linked trait and her husband has the dominant allele, predict the phenotypic ratio you would expect in the offspring?
15. Duchenne muscular dystrophy is caused by a sex-linked recessive allele. Its victims are almost invariably boys, who usually die before the age of 20. Why is this disorder almost never seen in girls?
16. A genetic defect in humans results in the absence of sweat glands in the skin. Some men have this defect all over their bodies, but in women it is usually expressed in a peculiar way: A woman with this defect typically has small patches of skin with sweat glands and other patches without sweat glands.
- What is the best explanation for the patchy pattern of sweat glands in woman with this defect.
  - What would be the genetic explanation for the very rare case of a woman who completely lacked sweat glands?
17. How might aneuploidism generate a male cat that was had a calico fur pattern?
18. Red-green color blindness is caused by a sex-linked recessive allele. A color-blind man marries a woman with normal vision whose father was color-blind.
- What is the probability that their first child will be a color-blind daughter?
  - What is the probability that their first son will be color-blind? (Note: The two questions are worded a bit differently.)
19. A space probe discovers a planet inhabited by creatures who reproduce with the same hereditary patterns seen in humans. Two phenotypic characters are height (T = tall, t = dwarf), and head appendages (A = antennae, a = no antennae). Scientists conduct a testcross of a heterozygote. The offspring are: tall-antennae, 46; dwarf-antennae, 7; dwarf-no antennae, 42; tall-no antennae, 5.
- Why do the scientists conclude the genes for these two traits are on the same chromosome?
  - Calculate the genetic distance between these two genes.
20. The ABO blood type locus has been mapped on chromosome 9. A father who has blood type AB and a mother who has blood type O have a child with trisomy 9 and blood type A. Using this information, can you tell in which parent the nondisjunction occurred? Explain your answer.
21. Suppose that having three nostrils is a Y-linked character. A woman with two nostrils mates with a man with three nostrils. What is the expected phenotypic ratio of their offspring?
22. Mary has blood type A and she marries John, whose blood type is B. They have three children: Joan, James and Pete. Joan has blood type O, James has blood type A, and Pete has blood type B. Explain how this is possible.

23. In the fruit fly, a gene influencing eye color has red (dominant) and purple (recessive) alleles. Linked to this gene is another that determines wing length. A dominant allele at this second gene locus produces long wings; a recessive allele produces vestigial (short) wings. Suppose a homozygous female with red eyes and long wings mates with a recessive male with purple eyes and vestigial wings. The F1 females are then testcrossed with purple-eyed, vestigial-winged males. The offspring of the testcross have the following characteristics 252 red eyes, long wings; 276 purple eyes, vestigial wings; 42 red eyes, vestigial wings; 30 purple eye, long wings; 600 offspring total. Based on these data, what is the genetic distance of the eye color and wing length genes.
24. In humans, the disease galactosemia is inherited as a simple recessive trait. A woman whose father had galactosemia intends to marry a man whose grandfather was galactosemic. They are worried about having a galactosemic child. What is the probability of this outcome?
25. What is the mode of inheritance for the pedigrees below? Write the genotypes of as many individuals as possible.



26. A spotted rabbit when crossed with a solid colored rabbit produced all spotted offspring. When these F<sub>1</sub> generation rabbits were crossed among themselves, they produced 32 spotted and 10 solid colored rabbits.
- Which of these characteristics is likely due to a dominant gene?
  - How many of the spotted rabbits in all the F<sub>2</sub> generation would be expected to be homozygous?
  - How many of the solid colored F<sub>2</sub> generation rabbits would be homozygous.
  - How could you tell which of the spotted rabbits in the F<sub>2</sub> generation were homozygous and which were heterozygous?
27. Recall that human sex chromosomes are XX for females and XY for males.
- Does a male child inherit his X chromosome from his mother or father?
  - If a female is homozygous for an X-linked gene, how many different types of gametes can she produce with respect to this gene?
  - If a female is heterozygous for an X-linked gene, how many different types of gametes can she produce with respect to this gene?
28. A normal visioned male marries a color-blind woman. She gives birth to a colorblind daughter. The husband claims the daughter is not his; the wife says the daughter IS his. Can you support either argument?
29. If a father is a carrier of recessive genetic disease Tay Sachs and a mother is normal, what are the chances that they will have offspring that suffer from the disease?
30. How many unique gametes can be produced through independent assortment by an individual with the genotype AABbCcDDEE?