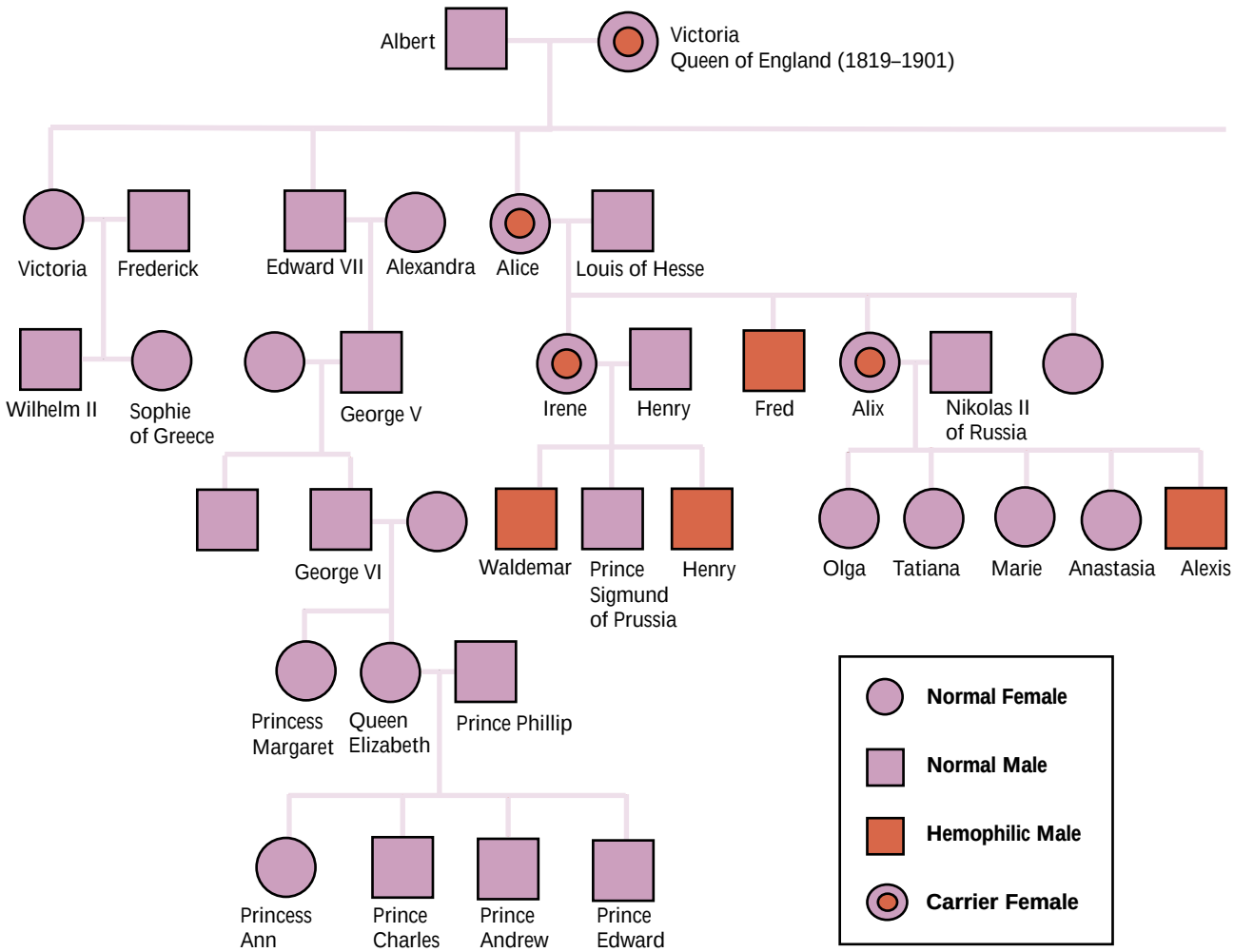
66 Patterns in Pedigrees

As you now know, genes are inherited and affect the characteristics of an organism. By growing *Nicotiana* seedlings, you've seen how a trait is inherited. You have also seen how Punnett squares can help make predictions about inherited traits in large numbers of offspring.

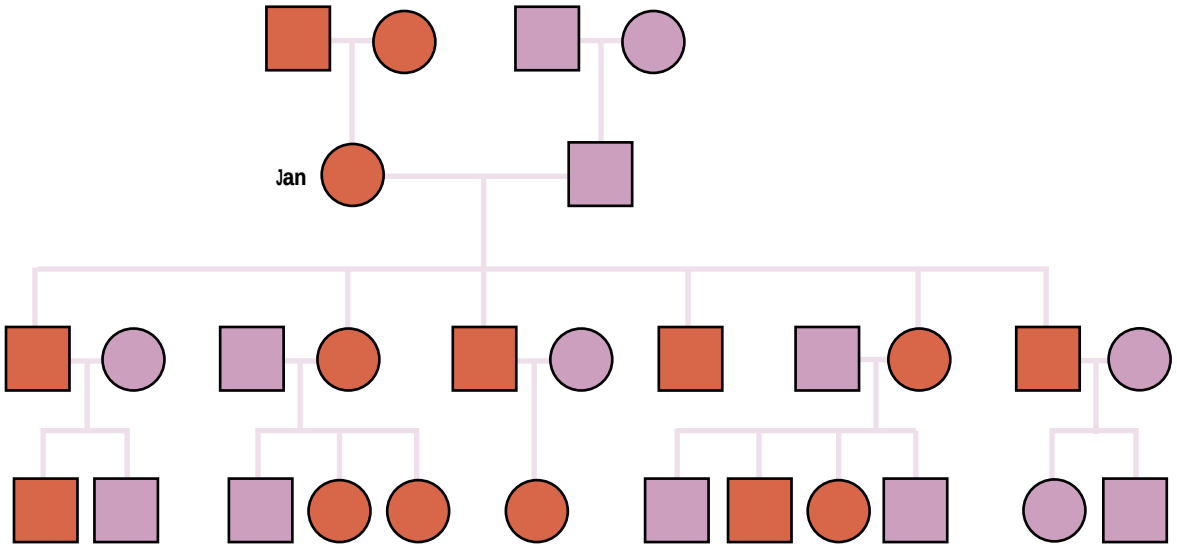
Studying human inheritance is more difficult. Scientists cannot perform breeding experiments on people. They must use other approaches when studying human genetics. Family histories, such as this one, provide one way to gather evidence about inherited traits in humans.

A Partial Pedigree of Hemophilia in the Royal Families of Europe



Note: The color red indicates an affected individual in Questions 2–4.

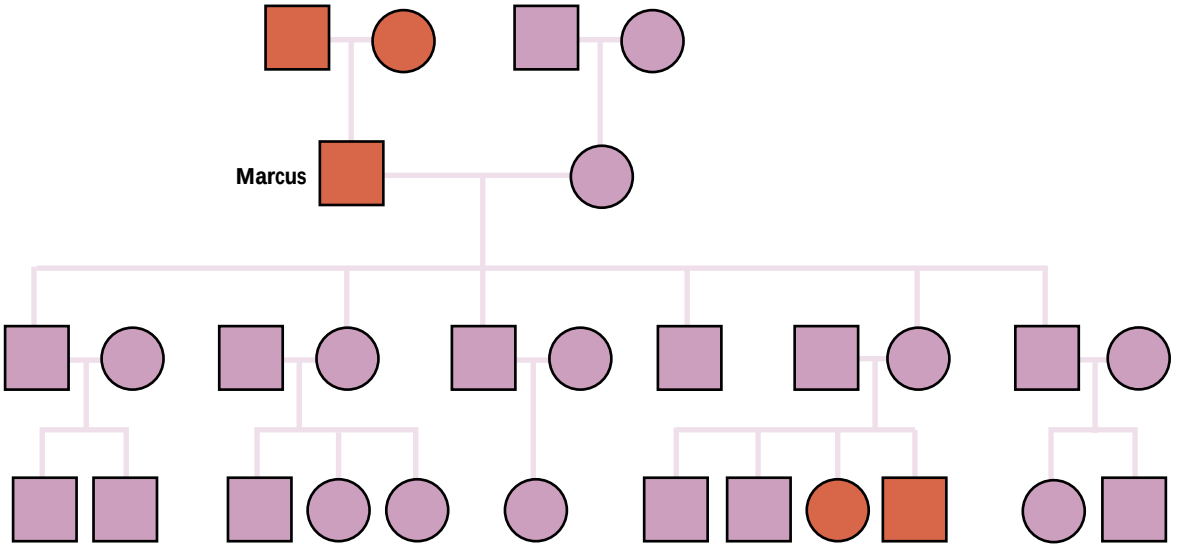
2.The pedigree shown below represents a genetic condition. Use the information it provides to answer the questions below. Use Student Sheet 66.1c to try out allele combinations for related individuals.



a. Is the condition most likely a dominant or a recessive trait? Explain your reasoning.

b. Is Jan most likely to be homozygous dominant, heterozygous, or homozygous recessive?

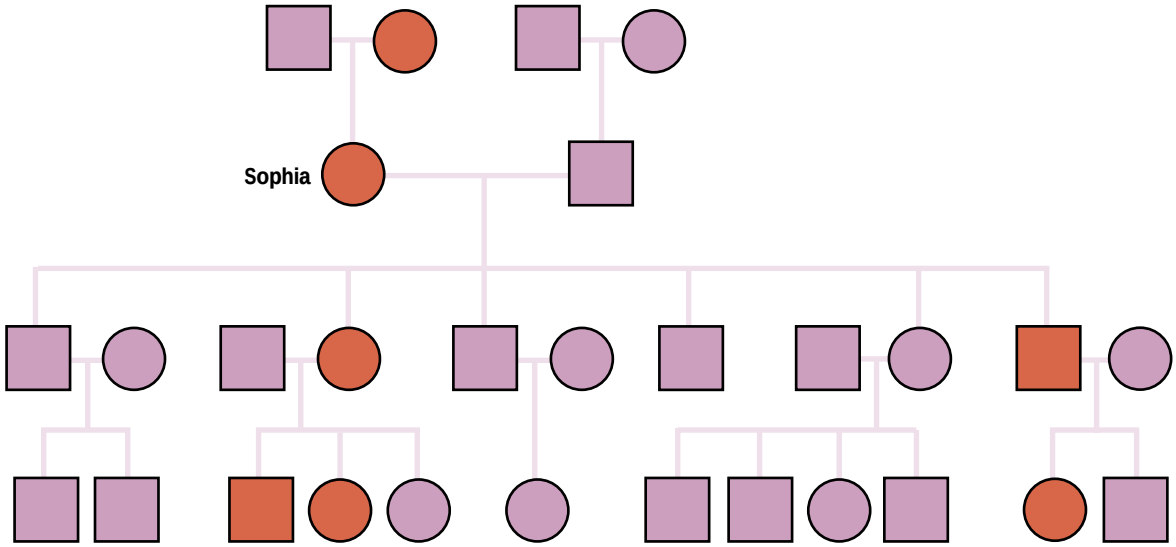
3. The pedigree shown below represents another genetic condition.



a. Is the condition most likely a dominant or a recessive trait? Explain your reasoning.

b. Is Marcus most likely to be homozygous dominant, heterozygous, or homozygous recessive?

4. The pedigree shown below represents a third genetic condition.



a. Is the condition most likely a dominant or a recessive trait? Explain your reasoning.

b. Is Sophia most likely to be homozygous dominant, heterozygous, or homozygous recessive?

5. The term *carrier* is used very differently in genetics than in the study of diseases.

a. What is being "carried" by a genetic carrier? What is being "carried" by a disease carrier?

b. How does transmission occur for genetic conditions? How does transmission occur for infectious diseases?

them central to the unit. Informational weblinks are provided on the SALI page of the SEPUP website. (See Extension in Activity 56, "Joe's Dilemma".)

Human ABO Blood Groups

The ABO blood types are familiar to students and useful for problem-solving practice, and are also essential in Activity 68, "Searching for the Lost Children." The human AB blood type is an example of co-dominance. An individual with type AB blood has both "A" and "B" antigens on the surfaces of the red blood cells. His or her body therefore does not make antibodies to either the A antigen or the B antigen.

Type A blood and type B blood are thus co-dominant traits, and type O blood is recessive to both of them. Type A people can be either AA or AO in their allele combinations; type B people can be either BB or BO. Note that the use of the symbols A, B, and O for the *alleles* that determine the A, B, O, and AB blood type *traits*, though convenient, can be confusing for students.

The A and B alleles cause two different antigens to be expressed on the surface of red blood cells. The O allele does not lead to the production of either antigen.

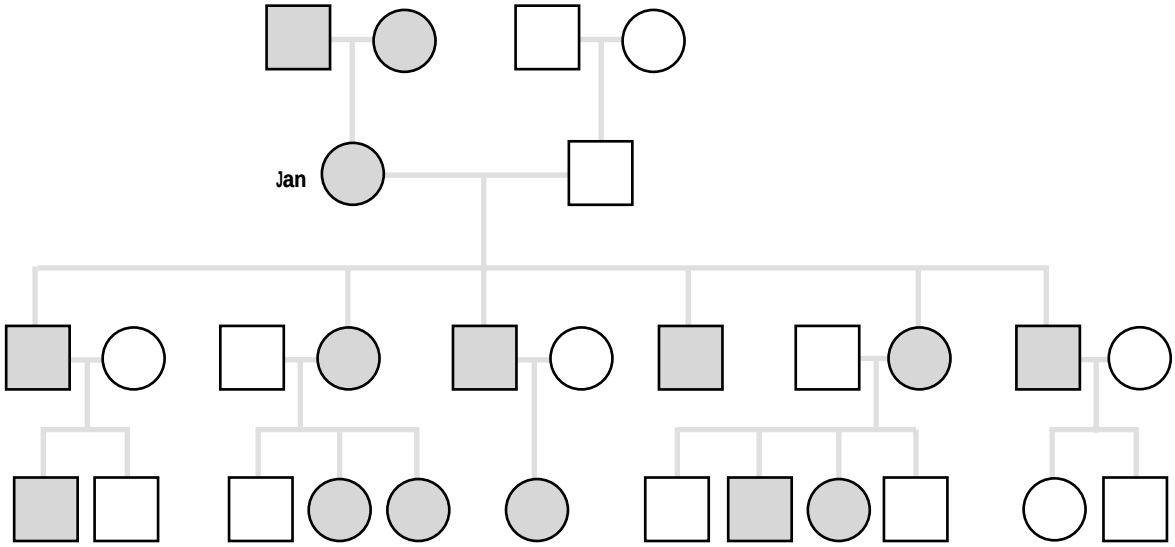
Blood Type	Allele Combinations	Antigen(s) on surface	Can donate to	Can receive from
O	OO	none	all	O only
A	AA or AO	A	A or AB	A or O
B	BB or BO	B	B or AB	B or O
AB	AB	A and B	AB only	all

"Blending Inheritance"

The concept of "blending inheritance" in animal and plant breeding is that traits in an offspring are a "blend" of the traits of its parents. It is a misleading term when applied to incomplete dominance, because it suggests the blending of traits themselves, rather than the blending of effects of two different alleles inside the cells of an organism.

REFERENCES

Griffiths, A. J. F., et al. *An Introduction to Genetic Analysis.* New York: W. H. Freeman and Company, 1993.

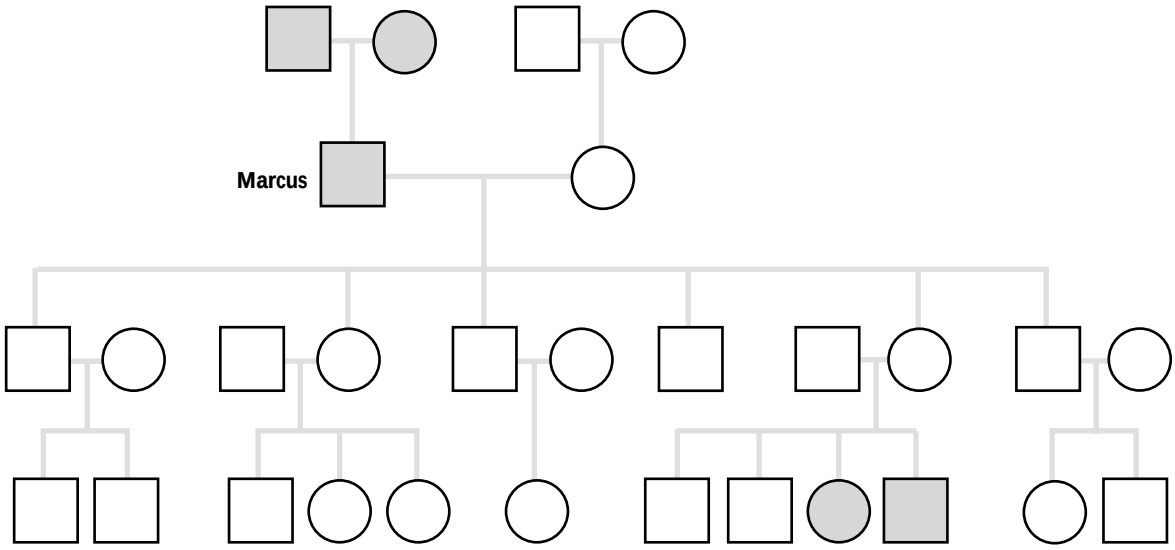


■ **Teacher's Note**: It is conceivable that the condition is recessive, but in that case, Jan's partner and all of her children's partners would have to be carriers. This is unlikely unless the trait were very common in the human population, or in whatever pool from which Jan's family selects mates.

b. Is Jan most likely to be homozygous dominant, heterozygous, or homozygous recessive?

Since all six of Jan's children have inherited the condition, which her husband does not have, it is likely—but not certain—that Jan carries two copies of the allele for the trait (homozygous dominant). For this to be possible, both of Jan's parents must have the condition (they do).

3. The pedigree shown below represents another genetic condition.



a. Is the condition most likely a dominant or a recessive trait? Explain your reasoning.

This condition skips a generation, which is typical of recessive traits. If the trait were dominant, it would be seen in at least one parent of any affected individual. Since none of Marcus's children has the genetic condition, but one of them has children who do, the condition must be recessive, and all of Marcus's children are carriers. Furthermore, since Marcus's fifth child (a daughter), has affected children, her husband must also be a carrier.

Have students note the similarity between this pedigree and Figure 2 on page D-67 in the Student Book, a pedigree for PKU. Students may insist on the possibility that this condition is dominant and arises in the youngest generation from mutations during reproduction. However, two children in that family are affected, making it even less likely that the condition is dominant (two of the same mutation among four children is improbable).

b. Is Marcus most likely to be homozygous dominant, heterozygous, or homozygous recessive?

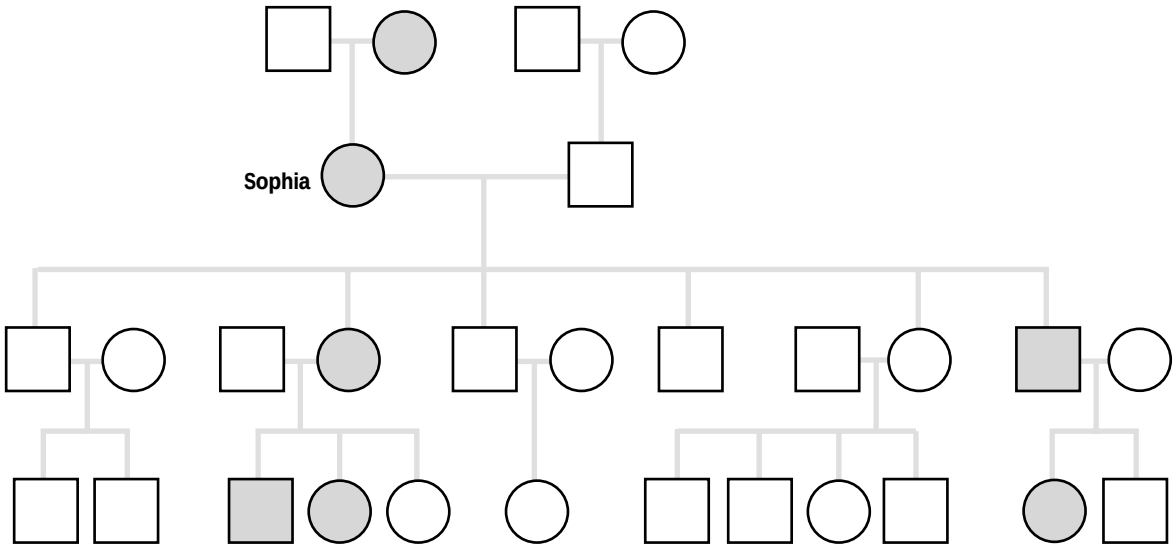
Since the condition is recessive, Marcus must be homozygous recessive, or he would not have the condition. However, all his children are heterozygous, i.e. carriers of this recessive trait.

4. The pedigree shown below represents a third genetic condition.

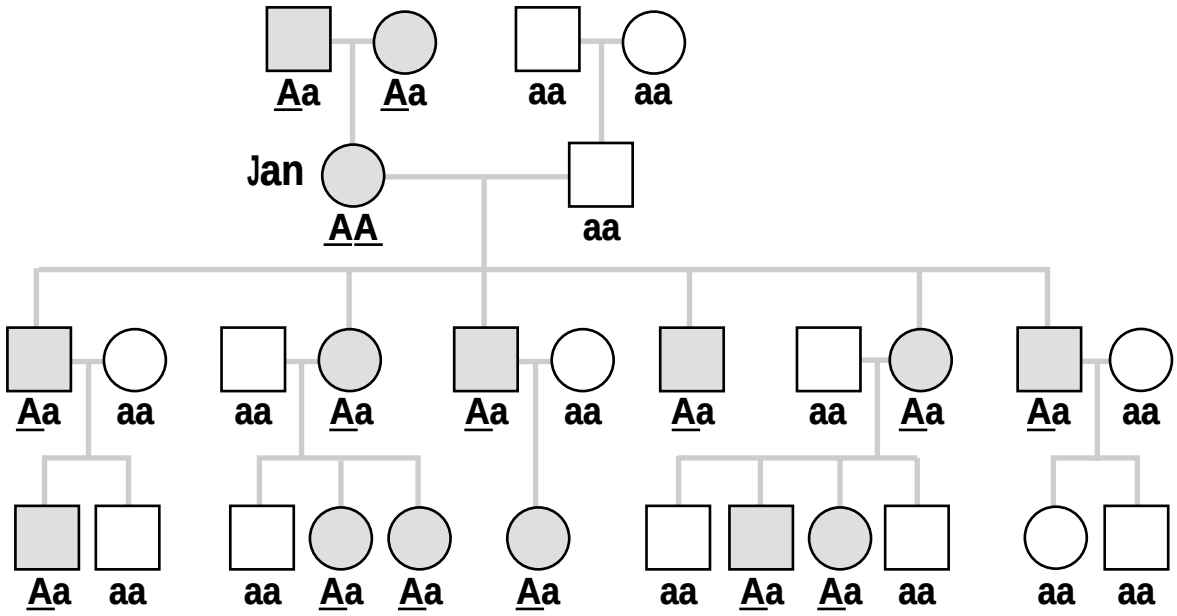
a. Is the condition most likely a dominant or a recessive trait? Explain your reasoning.

Although this condition happens to be less common within the pedigree than in Question 2 above, it is likely to be a dominant trait, as it does not skip any generations. It could be recessive if every partner of an affected individual happened to be a carrier (of which there are four examples in the pedigree), but this is improbable since most genetic conditions are rare.

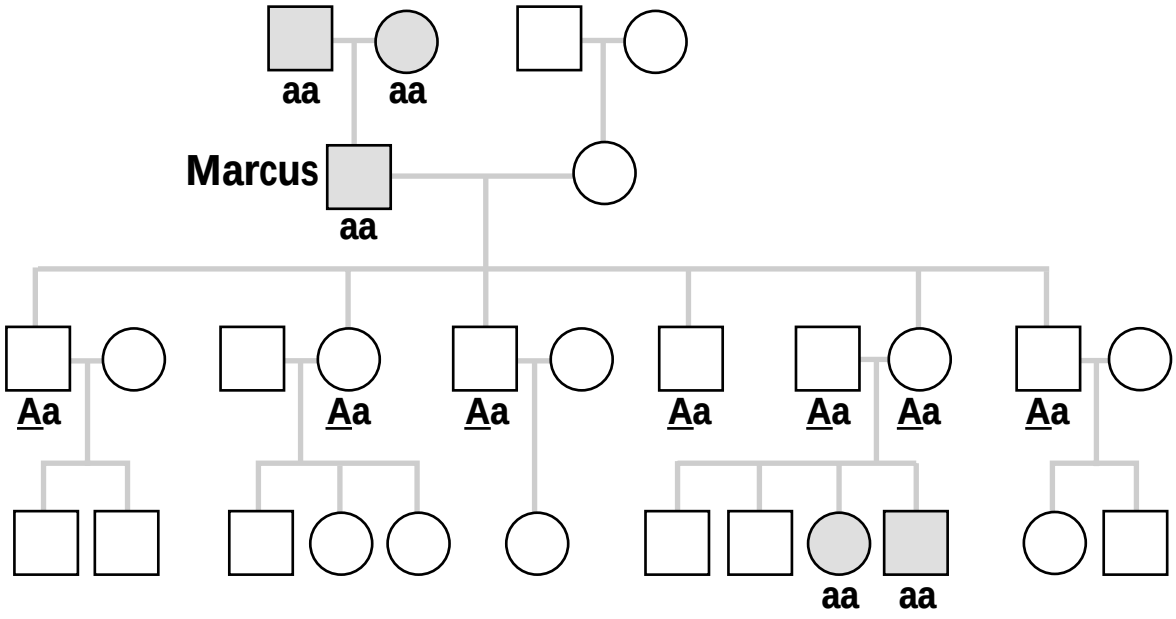
■ **Teacher's Note**: Only Sophia's affected children pass the gene on to her grandchildren, which would be somewhat unlikely if the trait



Three Kinds of Human Pedigrees



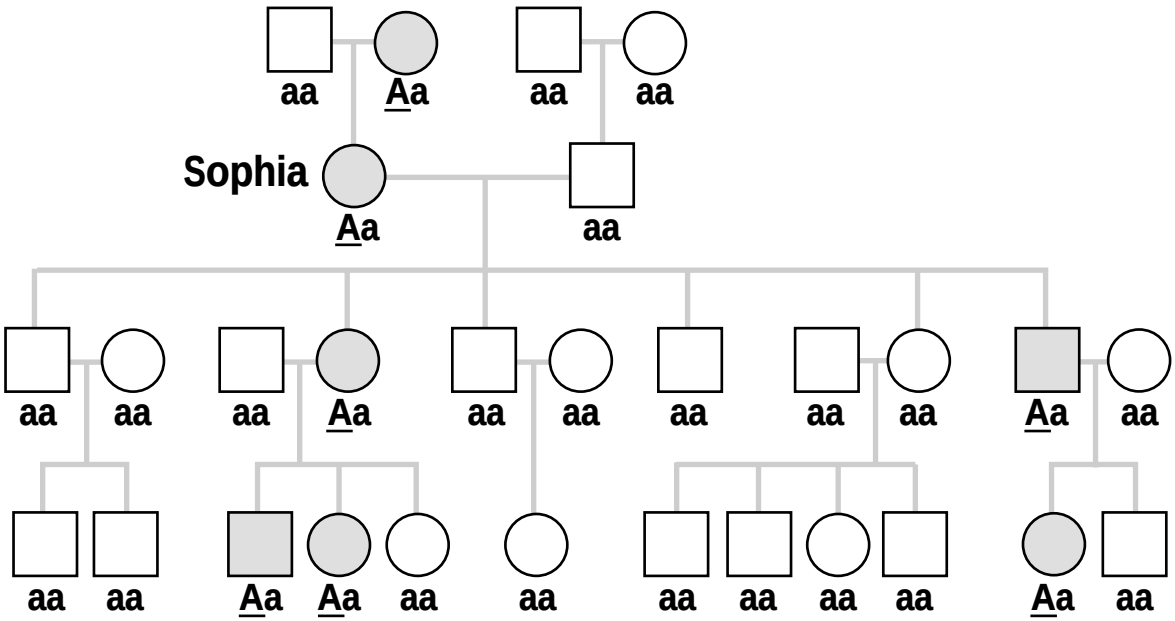
Question 2: A dominant trait



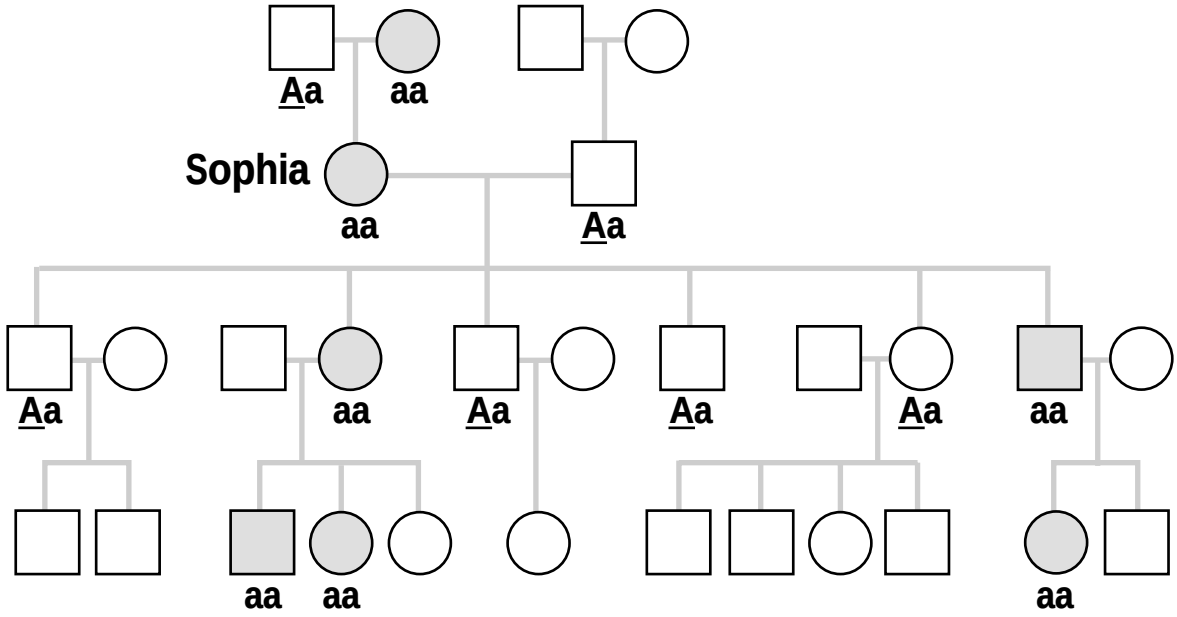
Question 3: A recessive trait

Three Kinds of Human Pedigrees (cont.)

Question 4



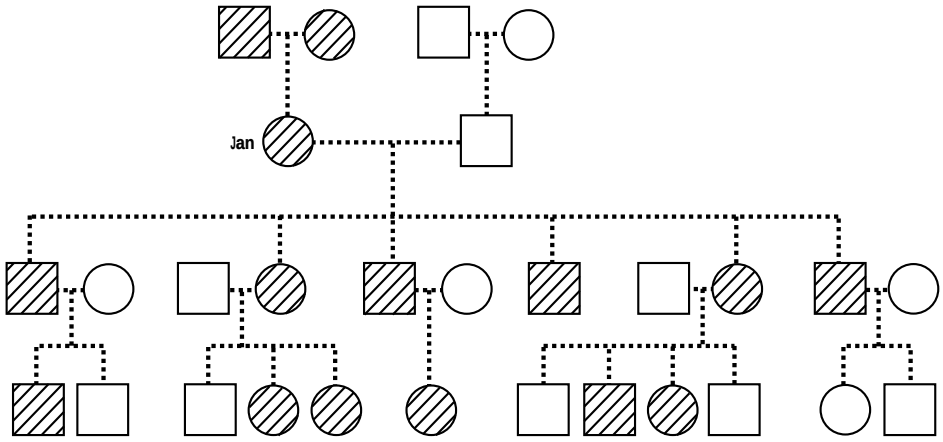
Likely to be a dominant trait



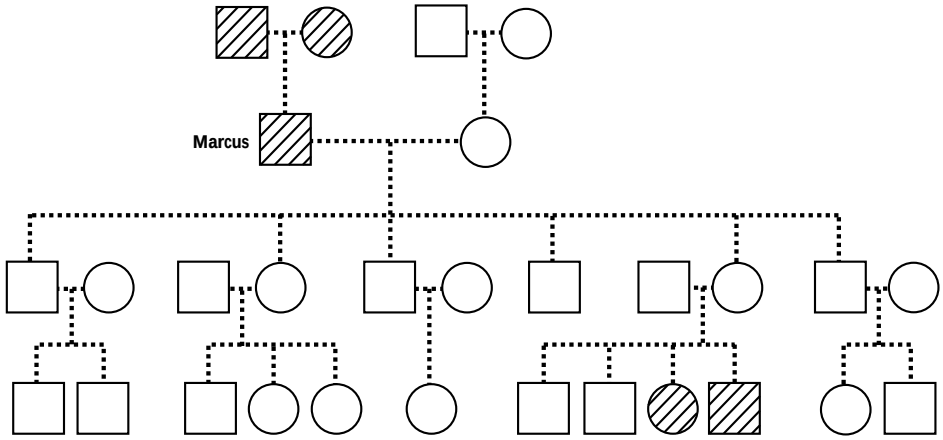
Possibly a recessive trait

Name _____ Date _____

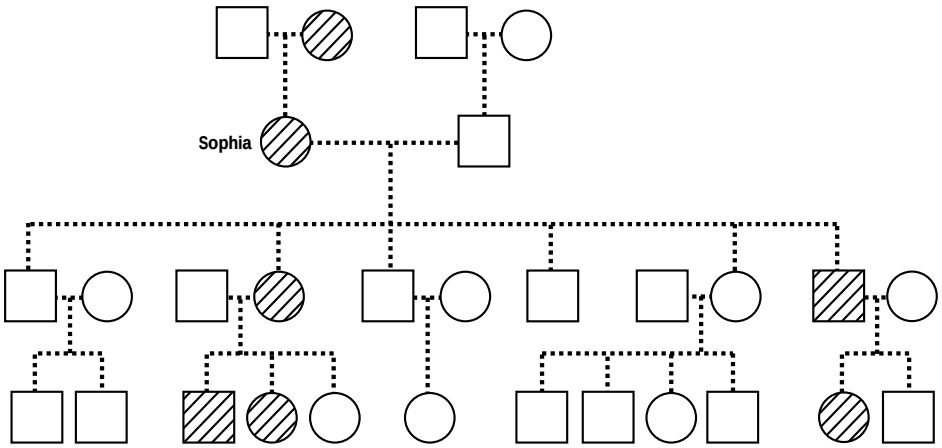
Pedigree Puzzles (cont.)



Analysis Question 2



Analysis Question 3



Analysis Question 4