On the other hand, someone who is homozygous dominant (AA), with two functional alleles, would have a zero percent probability of passing on an autosomal recessive condition to their offspring. Other examples of autosome recessive conditions include the blood disorder sickle-cell anemia, the fatal neurological disorder Tay–Sachs disease, and the metabolic disorder phenylketonuria.

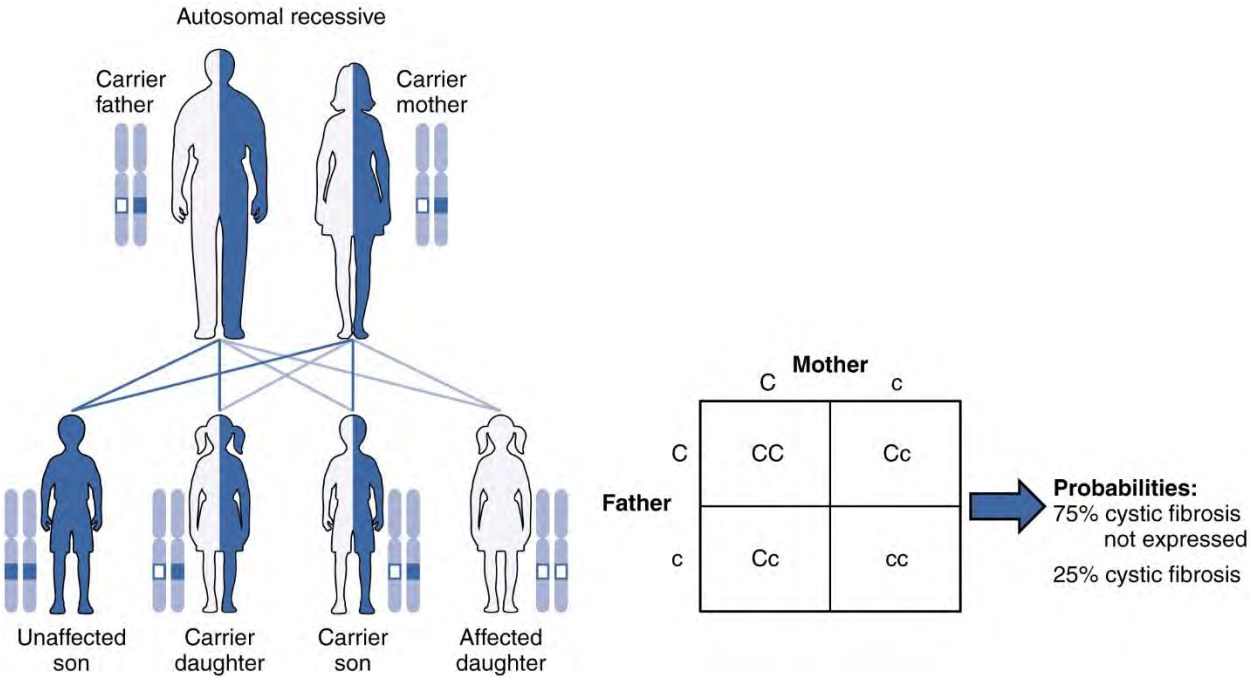
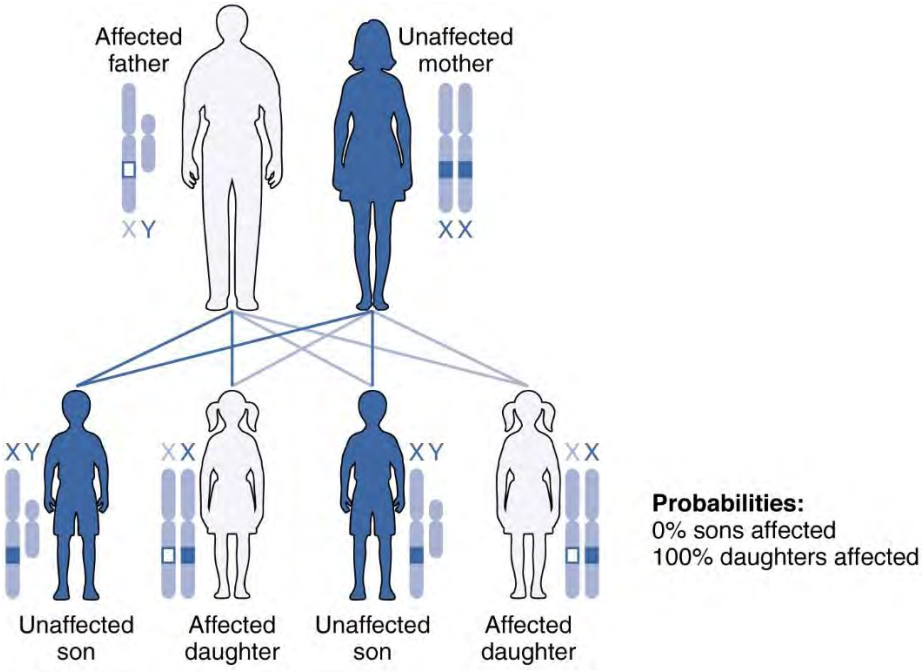


Figure 9.21 Autosomal Recessive Inheritance The inheritance pattern of an autosomal recessive disorder with two carrier parents reflects a 3:1 probability of expression among offspring. (credit: U.S. National Library of Medicine / Anatomy and Physiology OpenStax)

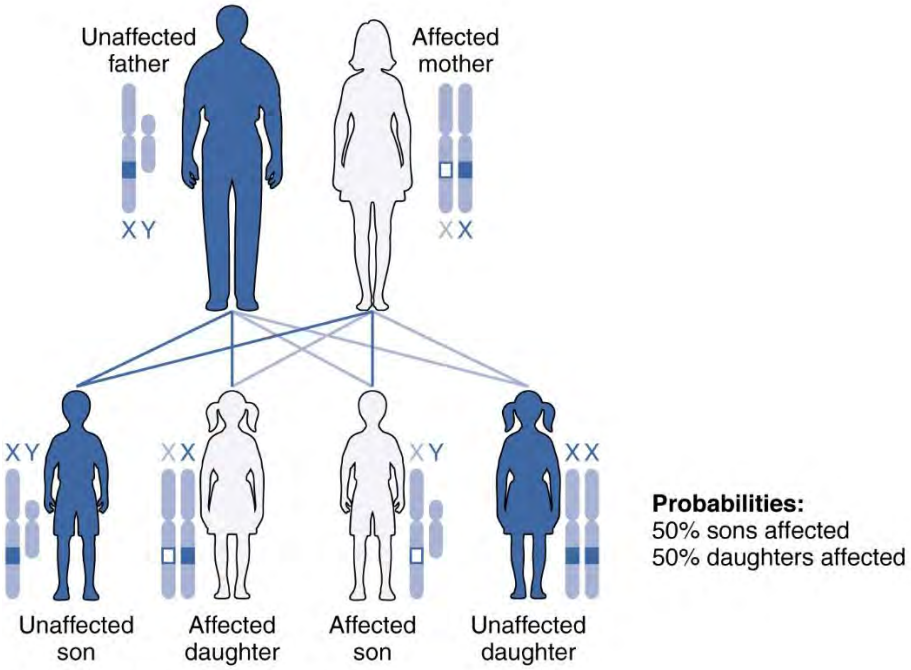
Sex-linked Disorders

A **X (sex)-linked** inheritance pattern involves genes located on the X chromosome of the 23rd pair (Figure 9.22). Recall that a male has one X and one Y chromosome. When a father transmits a Y chromosome, the child is male, and when he transmits an X chromosome, the child is female. A mother can transmit only an X chromosome, as both her allosomes are X chromosomes. Any male that has a X-linked condition received the faulty allele from his mother.

When an abnormal allele for a gene that occurs on the X chromosome is dominant over the recessive, functional allele, the pattern is described as **X-linked dominant**. This is the case with vitamin D resistant rickets. For example, an unaffected mother and an affected father have children. The affected father would pass the faulty gene on the X chromosome to all of his daughters, but none of his sons. He can only donate the Y chromosome to his sons (see Figure 9.22a). If it is the mother who is affected and she is homozygous dominant for the faulty allele, all her children, male or female, would have the condition. If the mother is heterozygous for the faulty allele, her sons and daughters have a 50 percent chance of inheriting the disorder (see Figure 9.2b).



(a) X-linked dominant, affected father



(b) X-linked dominant, affected mother

Figure 9.22 X-Linked Patterns of Inheritance A chart of X-linked dominant inheritance patterns differ depending on whether (a) the father or (b) the mother is affected with the disease. (credit: U.S. National Library of Medicine / Anatomy and Physiology OpenStax)

The **X-linked recessive** inheritance pattern is much more common because females can be carriers of the disease yet still have a normal phenotype. X-linked recessive conditions include red-green color blindness, the blood-clotting disorder hemophilia, and some forms of muscular dystrophy. For an example of X-linked recessive inheritance, consider parents in which the mother is an unaffected carrier, and the father does not have the condition. None of the daughters would have the condition because they receive a functional allele from their father. However, they have a 50 percent chance of receiving the faulty allele from their mother and becoming a carrier. In contrast, 50 percent of the sons would be affected (Figure 9.23).

With X-linked recessive conditions, males either have the condition or they do not; they cannot be carriers. Also recall, males always get the sex-linked recessive condition from their mothers. Females, however, may not have the condition but may carry the faulty allele and therefore pass it on to their offspring. A daughter that has an X-linked recessive condition had to get the faulty alleles from both her mother and her father. As you can imagine, X-linked recessive disorders affect many more males than females. For example, color blindness affects at least 1 in 20 males, but only about 1 in 400 females.

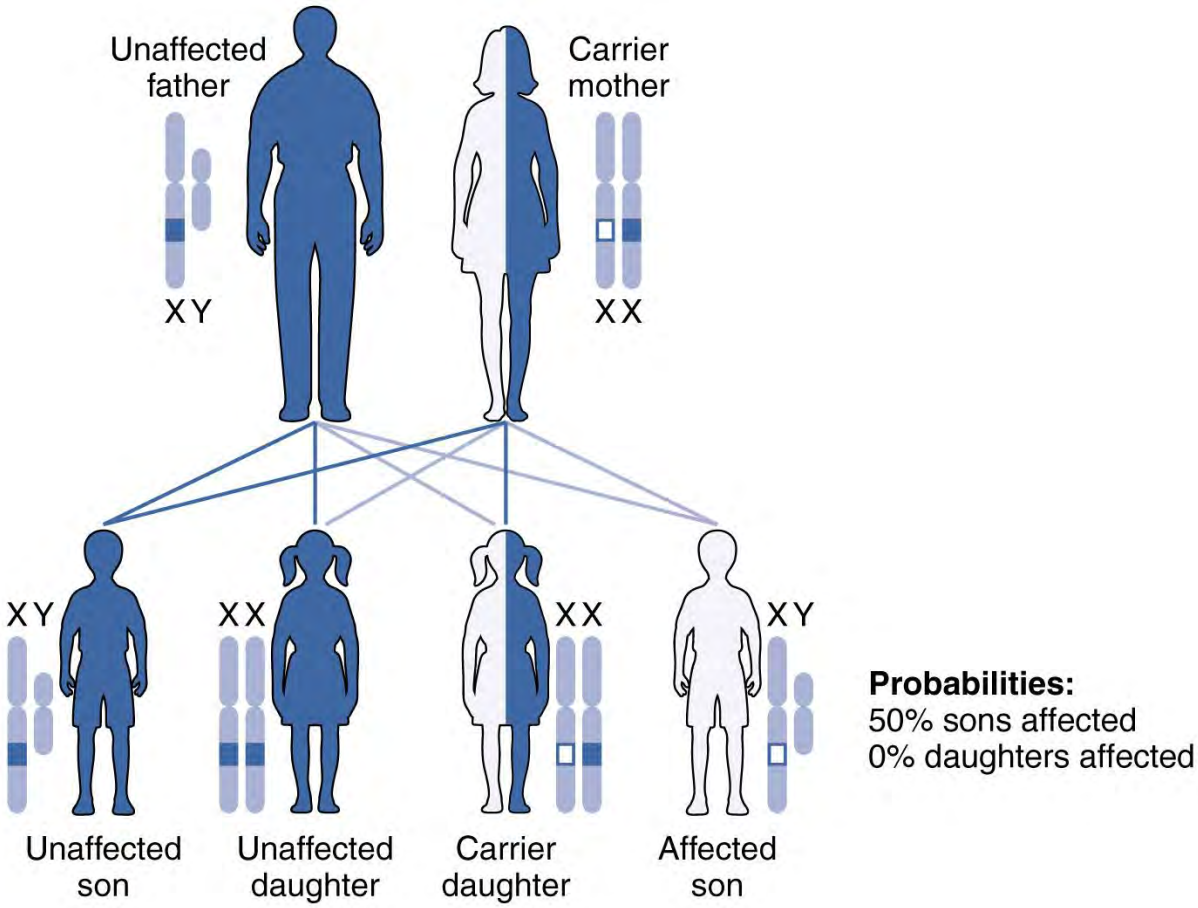


Figure 9.23 X-Linked Recessive Inheritance Given two parents in which the father is normal, and the mother is a carrier of an X-linked recessive disorder, a son would have a 50 percent probability of being affected with the disorder. In contrast, daughters would either be carriers or entirely unaffected. (credit: U.S. National Library of Medicine/ Anatomy and Physiology OpenStax)