Text Sections
Section 12.2 X-Linked Inheritance, p. 188

Introduction
X-linked traits are inherited on the X chromosome. In males, who only have one X chromosome, any allele that resides on the X will be expressed. In X-linked recessive traits in females, the trait will only be expressed if the female receives a particular allele on both of her X chromosomes. For this reason, X-linked traits are more common in males than females.

Learning Objectives
• Know what an X-linked trait is.
• Understand how the chromosomal makeup of males makes them more susceptible to X-linked recessive disorders than females.
**Narration**

**X-Linked Recessive Traits**

Various human genetic disorders are said to be X-linked, which means that the defective allele responsible for the condition is carried on the X chromosome. This produces a particular pattern of inheritance because females have two copies, and males only one copy, of the X chromosome. X-linked characteristics are therefore expressed more often in males than in females, and as a consequence, X linked diseases are expressed in more male than female victims.

Red-green color blindness is an example of a X-linked recessive disorder, because color blindness is not expressed if a functional allele is present. On the Punnett square, we can denote the X chromosome with the normal (functional) allele with a black X, and the X chromosome with the defective allele with a red X.

The possible progeny are XX (both normal alleles), XX (carriers with one normal allele), XY (normal males), and XY (color blind males). Note that the genotype must be either XX (female) or XY to express color blindness. A female of genotype XX has normal vision and is a carrier for the disorder; although she will not express the recessive trait, she can pass the defective X allele to her offspring.

As this example illustrates, the chromosomal makeup of males makes them more susceptible to X-linked recessive disorders than females. For a daughter to express color blindness, she must inherit two recessive alleles (genotype XX), but a son who inherits a single recessive allele will have the color blind genotype (XY). As a consequence, color blindness is much more common in males than in females.

**You should now be able to...**

- Give an example of an X-linked recessive trait.
- Use a Punnett square to explain why X-linked recessive disorders are more frequently expressed in males.
- Predict the offspring that could result from a cross between a normal male and a female who is a carrier for an X-linked recessive trait.
- Describe the offspring that could be produced from a cross between a normal male and a color-blind female.