

## Modern Genetics • 6.1 Enrich

**Sex-Linked Genes**

One example of a sex-linked trait is the blood disorder hemophilia A. Normally when a blood vessel is ruptured, such as when a wound in the skin occurs, the wound bleeds, but then the blood clots and a scab is formed.

People who have hemophilia A are unable to make certain proteins necessary for blood to clot properly. When cuts and other injuries are obtained, bleeding is difficult to stop without medical treatment. Hemophilia A is a recessive trait and the allele is carried on the X chromosome. This means that a female can be a carrier of the trait without actually suffering from the disorder. A male who receives the trait on the X chromosome will exhibit the disorder.

*Answer the following questions on a separate sheet of paper.*

- Complete the Punnett square shown here where  $X^h$  represents an X chromosome carrying the allele for hemophilia A.

	$X^h$	X
X		
Y		

- What percentage of the children of these parents will probably have hemophilia A? What gender will they be?
  - What percentage of the children of these parents will be carriers of hemophilia A? What gender will they be?
- Complete the Punnett square shown here where  $X^h$  represents an X chromosome carrying the allele for hemophilia A.

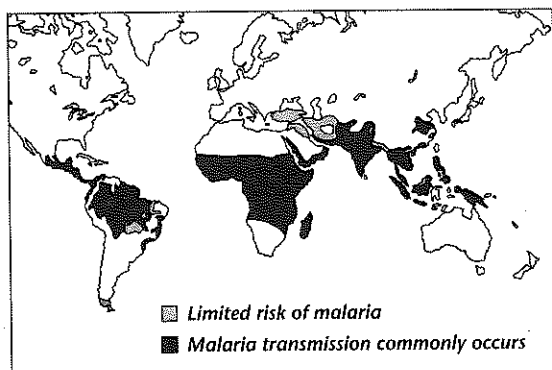
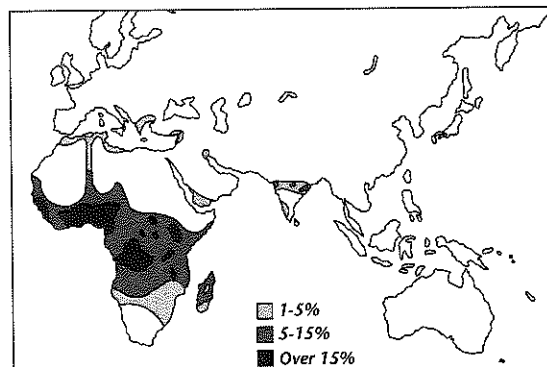
	$X^h$	X
$X^h$		
Y		

- What percentage of the children of these parents will probably have hemophilia A?
  - What percentage of the children of these parents will be carriers of hemophilia A?
- A husband and wife have three children: two boys and one girl. The father has hemophilia A. Neither of the boys has hemophilia A. The girl is a carrier of hemophilia A. What are the possible genotypes of the parents?

## Modern Genetics • 6.2 Enrich

**Sickle-Cell Allele and Malaria**

The allele for sickle-cell disease is most common in people of African ancestry. The reason for this probably has to do with the relationship between the sickle-cell trait and malaria. Malaria, a disease common in parts of Africa, affects red blood cells. Carriers of the sickle-cell allele are resistant to malaria. Scientists think that the sickle-cell trait helps carriers resist malaria. The map on the left shows the distribution of malaria worldwide today. The map on the right shows the distribution of the sickle-cell allele.

**Where Malaria Occurs Today****Percentage of Population with Sickle-Cell Allele**

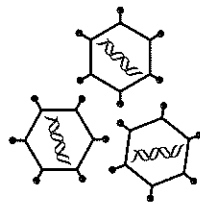
Answer the following questions on a separate sheet of paper.

1. Where is malaria most common today?
2. Where is the sickle-cell allele most frequent?
3. Malaria is caused by a microscopic parasite that infects the blood. Based on this fact, hypothesize why people with sickle-cell trait are resistant to malaria. (*Hint: A parasite is an organism that lives and feeds on or in another organism.*)
4. Suppose malaria were eliminated as a human disease. Predict how the frequency of the sickle-cell allele might change over time. Explain your prediction.

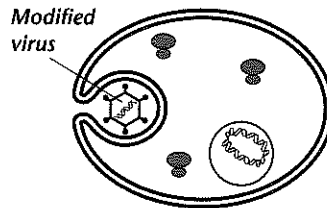
## Modern Genetics ▪ 6.3 Enrich

## A Closer Look at Gene Therapy for Cystic Fibrosis

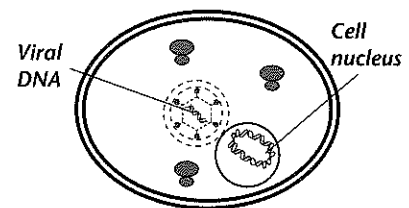
In people with cystic fibrosis, a protein called CFTR is absent from cells in the lungs. Without this protein, mucus builds up in the lungs and causes many of the symptoms of the disease. Gene therapy experiments were developed to attempt to treat cystic fibrosis. The process, which is illustrated in the figure below, involved genetically engineering a cold virus so that it could produce the CFTR protein. The virus was then delivered to the patient's lungs through a tube inserted through the mouth or nose.



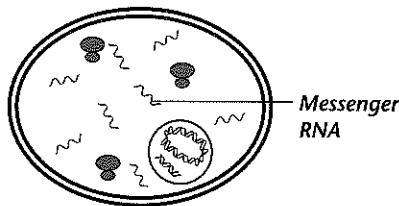
**A** Modified viruses carry a gene for the CFTR protein that is missing in people with cystic fibrosis.



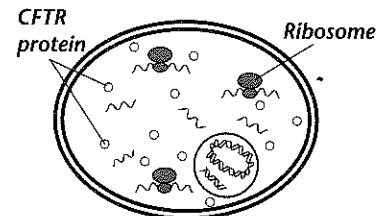
**B** After the virus attaches to a lung cell, the cell membrane begins to surround the virus.



**C** Cell enzymes break down the outer coat of the virus, and the viral DNA moves into the cell nucleus.



**D** In the nucleus, a strand of messenger RNA is produced by copying the genetic information in the viral DNA. The messenger RNA moves into the cytoplasm.



**E** The cell's ribosomes use the messenger RNA to produce the CFTR protein.

*Answer the following questions on a separate sheet of paper.*

1. What role does CFTR play in the body?
2. Why is it necessary for the viral DNA to enter the cell's nucleus before it can do its job?
3. Where in the treated cells is CFTR actually produced?
4. The cold viruses used in gene therapy for cystic fibrosis are genetically engineered so they cannot reproduce, and thus cannot cause a viral infection in the patient. Because of this, the therapy does not lead to a permanent cure for cystic fibrosis. Explain why this is the case.