BTR (55) Musings on Mosquitoes, Malaria, and Mutations

1. It is estimated that every person carries 5 - 8 harmful or mutated genes. Give 2 reasons WHY more people aren't born with hereditary diseases.

2. Explain what is meant by Heterozygote Superiority using Sickle-cell Anemia as an example.

	ENVIRONMENT: Warm & Humid with lots of malaria-carrying mosquitoes			Dry or Cool with NO malaria-carrying mosquitoes		
Genotypes: ↓	% of malaria Parasites in RBC's	% survive & reproduce	Cause of Death (when young)	% of malaria Parasites in RBC's	%survive & reproduce	Cause of Death (when young)
SS						
Ss						
ss						

3. Underline the genotypes above which offer humans the highest chance for survival in an environment full of malaria-carrying mosquitoes. Circle the genotypes above which offer humans the highest chance to survive and pass the genes on in an environment with NO malaria-carrying mosquitoes.

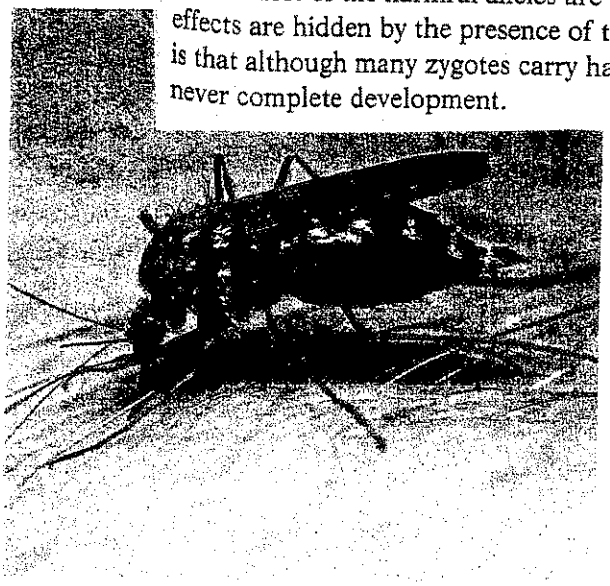
4. Based on the data above, there appears to be a selective pressure in an environment with lots of malaria-carrying mosquitoes which favors which ratio of dominant (S) and recessive (s) alleles?

100 - 0 75 - 25 50 - 50 25 - 75 0 - 100

5. Based on the data above, there appears to be a selective pressure in an environment with NO malaria-carrying mosquitoes which favors which ratio of dominant (S) and recessive (s) alleles?

100 - 0 75 - 25 50 - 50 25 - 75 0 - 100

There are more harmful or lethal alleles in the human population than you may think. Just as every book may have a few misspelled words, it is estimated that every person carries five to eight harmful genes. Given that fact, why aren't more people born with hereditary diseases? One answer is that most of the harmful alleles are recessive; in other words, their effects are hidden by the presence of the normal allele. Another possibility is that although many zygotes carry harmful alleles, most of these zygotes never complete development.



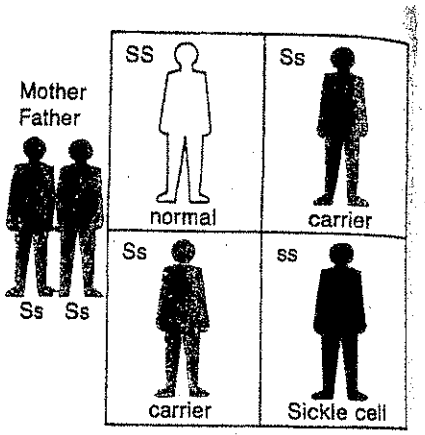


Figure 11-7 **The mosquito in the photograph, the female *Anopheles*, is responsible for the spread of malaria. The Punnett square shows the inheritance of the sickle-cell trait. The offspring that are homozygous recessive or heterozygous for the sickle-cell trait are more resistant to malaria.**

Heterozygote Superiority In some cases, although a certain allele is harmful in the homozygous state, that same allele actually presents an advantage to a heterozygous individual. Let's take another look at sickle-cell anemia. In the United States, one in ten African Americans carries the abnormal allele. However, depending on the area of Africa in which they live, as many as four out of ten Africans carry the allele for sickle-cell anemia. How can the difference be explained?

Malaria is a debilitating disease prevalent in parts of Africa, but uncommon in the United States today. Malaria is caused by a unicellular organism that invades red blood cells. Here the parasites multiply and soon rupture the blood cells. The newly released parasites invade other red blood cells and repeat the cycle. Periodic destruction of blood cells produces chills and fever and chronic illness. Some types of malaria can be fatal if untreated. People homozygous for normal hemoglobin are susceptible to malaria. Those who are heterozygous or homozygous for the sickle-cell hemoglobin resist malaria because the parasite does not thrive in cells with sickle hemoglobin. Therefore, in parts of Africa where malaria is prevalent, heterozygotes tend to live longer than people having the other genotypes. Unfortunately, those homozygous for sickle-cell usually die quite young. The likelihood of two heterozygotes producing children is great, and genetics tells us that every two out of four of those children will be heterozygotes, like the parents. Thus, the incidence of the recessive allele in African black populations remains high even though such a high incidence also results in many offspring having sickle-cell anemia. Because malaria is uncommon in the United States, heterozygotes have no such advantage, and over the years, the frequency of the recessive allele has declined due to natural selection.

The condition in which heterozygotes have an advantage over both homozygous genotypes, as in the case of sickle-cell anemia in Africa, is known as heterozygote superiority. This phenomenon may apply to other human genetic disorders as well.

The Results of a Higher Survival Rate Another reason that the frequency of some harmful alleles remains high has developed in recent years. In those countries with modern health care, people having some genetic disorders are living long enough to reproduce. Their genes, therefore, are passed on. For example, earlier in this century there was no treatment for people with a severe form of diabetes mellitus. Then, in 1922, insulin injections to control diabetes became available. Instead of dying young, diabetics began to lead more normal lives, to live longer, to marry, and to pass their genes to their descendants.