

AT A GLANCE FILM GUIDE

DESCRIPTION

When he was working in East Africa in the 1950s, Dr. Tony Allison became the first researcher to find a connection between the infectious parasitic disease malaria and the genetic disease sickle cell anemia. His discovery is among the first and best-understood examples of natural selection, in which the selective force, the adaptive mutation, and the critical molecules were all identified—and all in humans.

KEY CONCEPTS

- Sickle cell disease (also known as sickle cell anemia) is a potentially deadly genetic disease, while malaria is a potentially deadly infectious disease.
- Having two of the same alleles of a given gene means an individual is homozygous for that particular gene; if the alleles are not identical, then the individual is heterozygous for that gene.
- In areas where the malaria parasite is present, individuals who are homozygous for the sickle cell allele (who will get sickle cell disease) *and* individuals who are homozygous for the normal hemoglobin allele (who can contract malaria) both have a selective disadvantage.
- In areas where the malaria parasite is present, individuals who are heterozygous for the sickle cell allele are at a selective advantage because they are protected against malaria but do not get sickle cell disease.
- In the absence of malaria, there is selection against the sickle cell allele.
- Protection from malaria comes at the cost of more sickle cell disease in the population.
- A mutation that causes a genetic disease can also protect against an infectious disease.
- The sickle cell allele arose as a random mutation in the hemoglobin gene.

CURRICULUM AND TEXTBOOK CONNECTIONS

Curriculum	Standards
NGSS (April 2013)	LS1.A, LS2.A, LS2.C, LS3.A, LS3.B, LS4.B, LS4.C
AP (2012–13)	1.A.1, 1.A.2, 3.C.1, 3.C.2, 4.C.1
IB (2009)	4.1, 4.3, 5.4, D.2

Textbook	Chapter Sections
Miller and Levine, <i>Biology</i> (2010 ed.)	13.3, 14.2, 17.1, 17.2
Reese et al., <i>Campbell Biology</i> (9th ed.)	5.4, 14.4, 17.5, 23.1, 23.3, 23.4, 42.4

PRIOR KNOWLEDGE

Students should

- have a basic understanding of natural selection, evolution, and adaptation;
- know that some traits provide organisms with a greater chance to survive and reproduce;
- be familiar with the scientific process of testing ideas with evidence; and
- have a basic understanding of genetics, including inheritance patterns, the central dogma that DNA codes for proteins, and that mutations are changes in the DNA sequence.

KEY REFERENCES

Allison, Anthony C. "The Discovery of Resistance to Malaria of Sickle-Cell Heterozygotes." Mini-Series: Significant Contributions to Biological Chemistry over the Past 125 Years. *Biochemistry and Molecular Biology Education* 30, no. 5 (2002): 279–287.

Carroll, Sean B. *The Making of the Fittest: DNA and the Ultimate Forensic Record of Evolution*. New York: W.W. Norton & Company, 2006.