Unit 3.4 Learning Objectives

Preface

In the previous lessons, students learned that sickle cell disease is a genetic disorder that is passed on chromosomes from parents to child. It occurs when a person inherits defective beta-hemoglobin genes on both chromosomes and is therefore unable to produce normal hemoglobin. Because the gene is on an autosomal chromosome and two copies of the mutated gene are required for expression of the disease, sickle-cell disease is passed through generations as a non-sex-linked recessive trait.

In this lesson students will further study how inherited diseases are passed from parent to child, with a focus on sickle cell disease. They will analyze the gel electrophoresis results obtained from the Restriction Fragment Length Polymorphisms of Anna Garcia's family members to create a family pedigree for Anna's family. Next they will calculate the theoretical probability of a child inheriting sickle cell disease using Punnett squares and compare the results to experimental results. Finally, they will use pedigrees and Punnett squares to calculate the probability than an individual will inherit sickle cell disease. As an optional extension activity, students will simulate the effects of a high frequency of malaria on the allele frequencies of a population.

Understandings

1. The expression of a trait through the generations of a family can be visualized using a pedigree.
2. A Punnett square is a simple graphical way of discovering all of the potential combinations of genotypes of an offspring and can be used to determine the percent chance of each genotype occurring.

Knowledge and Skills

It is expected that students will:

- Explain how pedigrees can be used to determine the mode of inheritance of genetic diseases.
- Draw and analyze pedigree charts to illustrate passage of a trait through generations.
- Determine and compare the experimental probability and the theoretical probability of inheriting a trait.
- Analyze pedigrees to calculate the probability of inheriting a trait or disease.

Essential Questions

1. How are pedigrees used to track diseases?
2. Why does sickle cell disease run in families, yet is not present in every generation?
3. How can doctors and genetic counselors calculate the probability of a child inheriting a disease?
4. How does the presence of malaria in a region affect the frequencies of normal versus sickle cell alleles? (Optional)