INVESTIGATION

Time 30 minutes	TEACHER TESTED ✓
Teacher Preparation	
Student Difficulty	
Lab Binder Genetics, pp. 15–16	

Purpose Explore codominance by investigating the inheritance of sickle cell disease within a family.

Overview Students will analyze the test results for several members of a family in which the sickle cell trait appears. They will

- infer the genotypes of several family members from the type(s) of hemoglobin in their blood
- make a Punnett square to determine the possible genotypes and phenotypes of offspring of a family member

LAB MANAGEMENT

- Review codominance and the use of superscripts to represent codominant alleles.
- Use a different letter to identify alleles if students have a difficult time distinguishing between *S* and *s*.

Inclusion For students who have a hard time processing data, make a blank Punnett square with the possible gametes produced by each parent marked on it.

POST-LAB DISCUSSION

Have students evaluate their Punnett squares. **Ask**

- What gametes would Jerry form? Would they be produced in equal numbers? Hb^S and Hb^s gametes, in equal numbers
- What gametes would Jerry's wife form? Would they be produced in equal numbers? Hb^S and Hb^s gametes, in equal numbers
- What is the probability of Jerry and his wife having a child who has only normal hemoglobin? 25%

MATERIALS

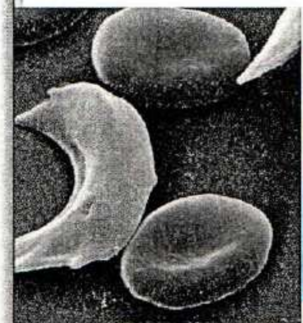
- paper
- pencil

PROCESS SKILLS

- Inferring
- Predicting

Do Monday as warm up

label



colored SEM; magnification 3500×

Codominance

Codominant alleles are both expressed in a person's phenotype. A heterozygote will have the traits associated with both alleles. In this lab, you will explore codominance by analyzing the results of tests for sickle cell disease within a family.

BACKGROUND

Sickle cell disease is caused by a change in the gene for hemoglobin, which is the oxygen-carrying protein in red blood cells. Individuals who are homozygous for the sickle cell trait often cannot endure exercise. Individuals who are heterozygous for the trait can have sickle cell attacks under extreme conditions. Normal individuals ($Hb^S Hb^S$) have only normal hemoglobin. Homozygous sickle cell individuals ($Hb^s Hb^s$) have only sickle cell hemoglobin. Heterozygous individuals ($Hb^S Hb^s$) have both normal hemoglobin and sickle cell hemoglobin.

Jerry Smith collapsed while running a race for his track team. A doctor said that he had a sickle cell attack. Genetic tests were run on several family members. The test results are shown below. An X indicates that form of hemoglobin in red blood cells.

PROBLEM How can you determine the genotypes of people in a family?

TABLE 1. FAMILY PHENOTYPES

Subject	Normal Hemoglobin	Sickle Cell Hemoglobin
Jerry Smith	X	X
Jerry's brother	X	
Jerry's younger sister	X	X
Jerry's youngest sister	X	
Jerry's father	X	
Jerry's grandfather	X	
Jerry's grandmother	X	X

PROCEDURE

1. Use the background information and the genetic test results to answer questions 1–4.
2. Use the background information and a Punnett square to help you answer question 5.

ANALYZE AND CONCLUDE

1. **Analyze** Are any of Jerry's siblings homozygous for the sickle cell trait? Are any of Jerry's siblings heterozygous for sickle cell disease?
2. **Analyze** What genotype is Jerry's father?
3. **Analyze** What genotypes are Jerry's grandparents?
4. **Infer** What is the genotype of Jerry's mother? Explain.
5. **Predict** If Jerry marries a female who is heterozygous for the sickle cell trait, what would be the possible genotypes and phenotypes of their children, according to your Punnett square?

Answers

Analyze and Conclude

1. no; younger sister is heterozygous
2. father is $Hb^S Hb^S$
3. grandfather is $Hb^S Hb^S$, grandmother is $Hb^S Hb^s$
4. Jerry's parents produced 50% normal offspring and 50% heterozygous offspring for sickle cell trait, so the mother is $Hb^S Hb^s$.
5. The children would have the following possible genotypes and phenotypes:
   - normal hemoglobin ($Hb^S Hb^S$)—25%
   - normal hemoglobin and sickle cell hemoglobin ($Hb^S Hb^s$)—50%
   - sickle cell hemoglobin ($Hb^s Hb^s$)—25%