

## Genetics and Sickle Cell

### **Introduction**

The purpose of this lesson is to introduce students to the idea that genes are passed down from parents to children. Students may already know that visible traits, such as hair color, skin color, the number of toes they have, etc. are determined by their parents' genes. This lesson is designed to have students discover that not all inherited traits are visible, that they can be carriers for traits without displaying the effects of the trait, and that traits stay within families over time.

### **Student Background Knowledge**

This lesson is designed for students who are familiar with the following vocabulary words: *allele, dominant, recessive, gene, trait, inherited*. Students should also know how to calculate the genetic possibilities of combining one gene from the mother and father together (i.e. a simple Punnett Square).

### **What the students will learn**

Students will learn the following ideas and words using this lesson: *homozygous dominant, homozygous recessive, heterozygous, carrier, pedigree, and how to read and interpret a family pedigree*.

### **Alignment to TEKS**

This lesson is designed to align to the following TEKS objectives:

SCI.7.2.A. Plan and implement investigative procedures

SCI.7.2.B Collect data by observing and measuring

SCI.7.2.C Analyze and interpret information to construct reasonable explanations from direct and indirect evidence

SCI.7.2.E Construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data

SCI.7.2.D Communicate valid conclusions

SCI.7.3.F Connect Grade 7 science concepts with the history of science and the contributions of scientists

SCI.7.4.A Collect, analyze, and record information using tools

SCI.7.4.B Collect and analyze information to recognize patterns

SCI.7.9.B Describe how organisms maintain stable internal conditions while living in changing external environments

SCI.7.11A Analyze changes in organisms that may result from internal stimuli

SCI.7.11.B Identify responses in organisms to external stimuli found in the environment

SCI.7.10.C Distinguish between dominant and recessive traits and recognize that inherited traits of an individual are contained in genetic material

### **Materials Provided**

- 1) Pedigree of hemophilia and the royal families of Europe/Russia
- 2) Hemophilia and history essay
- 3) Case studies of hemophilia presented to doctors
- 4) Pedigree of sickle cell family
- 5) Case studies of sickle cell presented to doctors

- 6) Pictures of normal blood cells
- 7) Pictures of sickle cells
- 8) Woody Guthrie Biography
- 9) Master pedigree of Woody Guthrie's family (from <http://www.usoe.k12.ut.us/curr/science/core/bio/genetics/huntington.htm>)

### Lesson Plan

- 1) Warm-up: Either a review Punnett Square problem, of the following question: Why do doctors ask if you have a "family history" of diseases such as cancer?
- 2) Review vocabulary words (however the teacher would like): *allele, dominant, recessive, gene, trait, inherited*
- 3) Have each student represent as much of their family history as they know (the teacher can pick a beginning point, for example, the great-grandparents): the marriages, children, etc. Allow the students to represent the history in a way that they choose.
- 4) Have the students re-write their history, this time using circles to represent the females, and squares to represent the males (just like a scientific pedigree)
- 5) Have students pair up. Each person in the pair must exchange pedigrees (the ones with circles and squares) and interpret the pedigree for the partner.
- 6) Partner/small group discussion: What information can you tell by looking at a pedigree? Then, do a large group discussion in which someone records the results. Likely answers will be phenotypic (visible) characteristics, rather than genotypic (genetic) characteristics.
- 7) Divide the class in half. Half of the class will do steps 8-10 and the other half will do steps 11-16.
- 8) **Half #1:** Pass out history of hemophilia in royal family and have small groups read and discuss the article. Have them try to interpret the article and how the illness could have affected history. The terms may be advanced, but the groups should determine that traits, which are invisible sometimes in parents, can become visible in children.

Pass out the picture of hemophilia in the royal family to each group. Using the picture and the article, have each group state in their own words (piece of poster, etc.) how hemophilia is inherited and why some children had hemophilia and some did not. Each group should present their findings to this half of the class and, then this half of the class should have a large group discussion about the two questions. Especially focus on the half-shaded circles because those are the carriers.

- 9) Ask the small groups to define the three types of people they see on a pedigree: those with hemophilia (the fully shaded spaces), without hemophilia (the blank spaces) and the carriers of the hemophilia allele (the half-shaded spaces)  
Students should work out that the blank people do not have the disease at all and cannot give the disease to their children. The half-shaded people do not get sick, but can give the disease to their children. The fully-shaded people are sick and will definitely give the disease to their children. The students should also figure out that the allele is carried by the mom (On the X-chromosome. It is a sex-linked disease)
- 10) When Half #1 is finished, they must be ready to present their research and conclusions to Half #2 in some kind of presentation.
- 11) **Half #2:** Pass out sickle cell anemia case studies and have students in small groups discuss what they think the disease is and how it affects the body.
- 12) Introduce the terms *homozygous dominant*, *homozygous recessive*, *heterozygous*. Ask groups to try to interpret what the words mean. Then, show a visual representation of the terms. Example, AA, Aa, aa
- 13) Tell students that sickle cell gene is made of 2 recessive alleles, and a person must be homozygous recessive to have the disease.
- 14) Pass out and the pedigree with a few genotypes on it. Give each group directions that they are to fill in the blank spaces by figuring out the genotypes using Punnett Squares. Most likely, each group will create different pedigrees because they will use different genotypes.
- 15) Ask each group to correctly label on their pedigree which people are *homozygous dominant*, *homozygous recessive* and, *heterozygous*, and there which people have sickle cell, which people do not have sickle cell, and which people are carriers for sickle cell.
- 16) When Half #2 is finished, they must be ready to present their research and conclusions to Half #1 in some kind of presentation.
- 17) After presentations and questions, have students read the Woody Guthrie biography small in groups/pairs. Woody suffered from Huntington's disease, which is a carried on a dominant allele. One abnormal allele will cause the disease. Therefore each of his children have a 50% chance of getting his abnormal allele, or a 50% chance of getting his normal allele. This biography gives the students the information they need to create a pedigree of Woody's life. Included

in this lesson is a master pedigree for the teacher. Students need to create a pedigree and determine the percent chances of each of his children becoming afflicted with Huntington's. The black spaces filled in on the master pedigree are known cases of Huntington's, the question marks are unknown genotypes.

18) Closure. Have each individual student complete the following questions:

a) A pedigree is useful because

---

---

b) A genotype of **AA** is (homozygous dominant, homozygous recessive, heterozygous)? Circle one and explain why

---

---

b) A genotype of **Aa** is (homozygous dominant, homozygous recessive, heterozygous)? Circle one and explain why

---

---

b) A genotype of **aa** is (homozygous dominant, homozygous recessive, heterozygous)? Circle one and explain why

---

---

C) Genes are made of how many alleles? \_\_\_\_\_

**Homework:** Pretend you are a doctor/genetic counselor. A couple is seeking advice from you about whether or not to try to have a baby. Both parents are carriers of the sickle cell allele. How would you advise these parents? What would each genetic outcome mean for the baby as it grows up?

**ESL/ELL/LEP/Other Modifications:**

- Shorten the reading sections or read aloud
- Use big posters that the students help create and label when learning vocabulary words
- Listen to some of Woody Guthrie's music
- Do not divide the class into 2 halves; rather do the hemophilia and sickle cell work as a whole class

**Assessment possibilities:**

- Posters
- Daily participation grades
- Presentations
- Various pedigrees
- Closure

-Homework