

STEM PROJECT ACTIVATOR

Sickle Cell Trait and Reducing Risk in Sports

Project Details

COURSE

Life Science, Biology, Anatomy and Physiology

GRADE SPAN

9–12

DURATION

Two forty-five to sixty-minute sessions

CONCEPT

Genomics and Genetic Testing

OVERVIEW

In the 2010–11 academic year, the National Collegiate Athletic Association (NCAA) instituted universal screening among Division I athletes for the sickle cell trait. This policy was implemented in an attempt to reduce the exercise-related sudden death rate, which is 10 to 30 times higher in sickle cell trait carriers compared to non-carriers. In this project, students will investigate sickle cell trait, research the science behind genetic screening for sickle cell, and consider the benefits and drawbacks of universal screening programs. Students will apply what they have learned as they create an informational infographic that synthesizes their key findings and takes a position on the issue

ESSENTIAL QUESTION

How can we use genetic screening techniques to lower the risks of participating in sports?

MATERIALS

- Device with internet access and projection capabilities, one for the teacher
- Sticky notes or notecards, several per student
- Videos: to project
 - NCAA’s Sickle Cell Trait and Student Athlete [video](#)
 - 9 Types of Infographics [video](#)
- Inheritance diagram to project: [link](#)

- Copies of articles listed in Create, Step 4 for each student or device/internet access for pairs or individual students
- Student Capture Sheet, one per student
- Model Student Capture sheet, one for the teacher
- Infographic Evaluation Criteria, one per student
- White copy paper, at least two sheets per student
- Colored pencils, markers, and/or crayons for students to share

PROCEDURE

Think

- 1 Present students with the following scenario: Your best friend was just accepted into their top choice college with a sports scholarship. The school requires all of their athletes to either get genetic testing for sickle cell disease or sign a waiver releasing the school from all liability. Your friend dislikes going to the doctor and really wants to just sign the waiver form, but you have a gut feeling that you should try to convince your friend otherwise...
- 2 Ask: If you were in this situation, what information would you need to make a well-informed decision? Students can discuss this question using a Table Top Texting Strategy. To do this, give groups of four students several notecards or sticky notes. Instruct students to respond to the question by writing down their answer and putting it on the table in front of them. Group members should respond to each other by “texting” (writing a comment or question) back and forth.
- 3 Debrief on the texting conversation and discuss the information that the students would need in order to help their friend make an informed decision. Necessary research/information may include: additional information about the genetic test and what it entails, risks and side effects of sickle cell trait, and other risks/benefits of genetic testing especially when related to sports.

Create

- 1 Distribute the Student Capture Sheet, and explain that students will perform research using videos and texts in order to help their friend understand the advantages and disadvantages of genetic testing for sickle cell trait. Explain that students will eventually be using this information to create an infographic that they will present to their friend, but first they will focus on gathering information. Before they begin researching, encourage students to review the handout and summarize the information they must collect.

- 2 Begin by showing the NCAA's Sickle Cell Trait and Student Athlete Video. Students should take notes as they watch, and pay particular attention to the information presented about sickle cell trait and how it affects the student athlete.
- 3 Next project the [CDC's Diagram](#) of Sickle Cell Trait inheritance. Encourage students to read from the top of the webpage until the diagram. Discuss the implications of this gene and then encourage students to record notes on their capture sheet.
- 4 Now that students have a basic understanding of sickle cell trait, they will independently perform additional research about sickle cell trait and genetic testing. They should continue to fill in their capture sheet, and anticipated student responses are included in the Model Student Capture sheet. Suggested resources include but are not limited to:
 - o CDC: What You Should Know about [Sickle Cell Trait article](#)
 - o Healthline: [Explanation of Electrophoresis article](#)
 - o NCAA: [Sickle Cell Trait Student Athlete Fact Sheet](#)
 - o American Society of Hematology: [Statement on Screening for Sickle Cell Trait](#) and Athletic Participation (Strong statement against testing)
 - o Sickle Cell Trait and the [Student-Athlete Part II video](#)
- 5 When students have sufficient notes in all sections of their capture sheet, allow them time to synthesize their research. Ask them to begin considering: Based on your research, would you advise your friend for or against sickle cell genetic testing? Encourage students to find a peer who has a different opinion and discuss their thoughts.

Connect

- 1 Now that students have completed their research, it's time for them to organize it into an easily digestible infographic. Distribute the Infographic Rubric to students and review it as a class. Encourage students to discuss how it corresponds to their capture sheet.
- 2 Show a segment from this [9 Types of Infographic video](#) (from 1:47 to 2:53) to provide background on the Informational Infographic. Students may also benefit from researching additional examples of informational infographics.
- 3 Once students understand the main idea of informational infographics, students must determine which information should be present on their own infographic. They also need to consider how they will organize their infographic in a way that portrays both sides of the issue but also persuades the viewer of their own opinion. Remind students of the power of clarity, organization, and color to make

their infographic as influential as possible. Then pass out the white paper and allow students to begin making their own! If time allows, students may create a final copy using a free online infographic tool or a graphic design software program.

Career Connections

Read through each of the career descriptions below, and consider: What role(s) would each career have played in the scenario you just investigated? Which career sounds the most interesting to you and why?

- **Clinical Lab Scientists** work in laboratories to process patient blood samples and analyze patients' DNA. They may work closely with geneticists and doctors to help them reach conclusions. To watch a profile about a clinical lab scientist, click [here](#).
- **Genetic Counselors** collaborate with geneticists and doctors in order to help patients understand the risks, benefits and outcomes of genetics tests and treatments. To learn more about the daily life of a genetics counselor, click [here](#).
- **Geneticists** study genes, including the role they play in the human body and the effects of both "normal" and mutated genes. To learn more about the road to becoming a geneticist, click [here](#).



Name _____ Date _____

Student Capture Sheet: Investigating Genetic Testing in Sports

Directions: Use the grid below to record notes about sickle cell trait and genetic testing. Think critically about what kind of information will be important for your “friend” as they decide whether to participate in sickle cell trait genetic testing.

Sickle Cell Notes:	Source(s)
Genetic Testing Background Notes:	Source(s)
Reasons FOR Testing for Sickle Cell Trait:	Source(s)
Reasons AGAINST Testing for Sickle Cell Trait:	Source(s)
Additional Notes:	Source(s)

MODEL Student Capture Sheet: Investigating Genetic Testing in Sports

While answers may vary, the grid below provides examples of key information that students may find as they research this topic.

Sickle Cell Trait Notes:

- Sickle cell trait occurs when a child inherits a sickle hemoglobin gene from one parent and a normal hemoglobin gene from another parent.
- If a child inherits a sickle hemoglobin gene from both parents, they will have the much more serious sickle cell disease.
- Sickle cell trait does not develop into sickle cell disease.
- Two people with sickle cell trait have a 1 in 4 chance that their child will have sickle cell disease.
- While sickle cell trait is more common in people of Far Eastern, Middle Eastern, Mediterranean and African decent, it is present in people of all backgrounds.
- Sick cell trait normally shows no symptoms so it is possible to have it and not know it. Serious side effects associated with sickle cell trait are rare. However, some athletes have experienced distress, collapsed or even died as a result of sickle cell trait.
- Athletes who know they have sickle cell trait should take precautions when training. Precaution include: Condition and build intensity gradually, rest between intense repetitions, and stop all activities when experiencing abnormal weakness, pain or fatigue.

Genetic Testing Background Notes:

- Testing for the patient includes a simple blood test that tests for a mutated hemoglobin gene known as Hemoglobin S. (Normal blood contains Hemoglobin A, and those with sickle cell trait and sickle cell disease possess a mutated gene.)
- Hemoglobin is a protein found in red blood cells that carries oxygen throughout the body. Mutated Hemoglobin S genes change shape and become rigid over time, and as a result have trouble carrying oxygen throughout the body.
- If a patient tests positive for Hemoglobin S, they will be asked to get their blood drawn again. This time, their blood will be assessed using hemoglobin electrophoresis. During this process, an electric current breaks the blood's hemoglobin into different bands. The bands are compared to a healthy sample in order to determine which types of hemoglobin are present. A person with a combination of normal and sickle hemoglobin in their red blood cells have sickle cell trait. This means they inherited a mutated hemoglobin S gene from only one parent.

Reasons FOR Testing for Sickle Cell Trait:

- Athletes who unknowingly have sickle cell trait and over-exert themselves have a higher risk of experiencing physical distress such as collapsing and even death.
- Factors such as dehydration, heat, not warming up enough, asthma and altitude can increase the risk of side effects and complications for athletes with sickle cell trait.
- Those who know they have sickle cell trait can take precautions to ensure they are safe when participating in athletics.
- Sickle cell trait is a life-long condition, but it does not mean sports can't be played. Instead, it means the necessary precautions must be taken.
- Two adults who have sickle cell trait can pass their genes to an offspring, who then has a 1 in 4 chance of developing the more serious sickle cell disease.
- The test is relatively simple and easy to take.

Reasons AGAINST Testing for Sickle Cell Trait:

- The American Society of Hematology states that screening for sickle cell trait should be voluntary and private—not publicly required.
- A diagnosis of sickle cell trait is a lifelong condition. As such, testing should be performed by a medical professional and should be accompanied by counseling.
- All athletes and coaches should follow basic guidelines and interventions to reduce exertion-related injuries and deaths, regardless of athletes' sickle cell status. This will make athletics safer for all involved.
- Required testing and the subsequent results could lead to unnecessary stigmatization.
- Required testing and the subsequent results could lead to racial discrimination.



Name _____ Date _____

Infographic Evaluation Criteria

Your work will be evaluated based on the following criteria:

- A succinct and accurate description of sickle cell trait, including relevance and risk
- A concise and accurate description of genetic testing for sickle cell trait
- Advantages of getting testing for sickle cell trait are correct and described in detail
- Disadvantages of getting testing for sickle cell trait are correct and described in detail
- Noticeable persuasion tactics toward one side of the issue
- Information presented in a clear, logical and visually appearing manner

Criteria	2	1	0
Sickle Cell Trait Description	Infographic clearly and impactfully describes the risk associated with sickle cell trait and why it is relevant to student athletes.	Infographic clearly and impactfully describes either the risk associated with sickle cell trait or its relevance to student athletes but not both, or poorly describes both the risk and relevance in a manner that is unclear.	Information about sickle cell trait is incorrect or missing.
Genetic Testing Description	Infographic clearly and concisely outlines what genetic testing for sickle cell trait entails.	Infographic describes what genetic testing entails but it is not concise or clear.	Information about genetic testing is incorrect or missing.
In Support of Sickle Cell Testing	Infographic clearly and concisely explains at least 2 reasons in support of getting tested for sickle cell trait, including how these reasons affect a student athlete.	Infographic clearly and concisely describes one reason in support of getting tested and why it affects a student athlete but not two, or describes two reasons in a way that is unclear.	The advantages are incorrect or missing.
Reasons Against Sickle Cell Testing	Infographic includes at least 2 reasons against getting tested for sickle cell trait, specifically targeted to a student athlete.	Infographic includes at least two mentions of the drawback of getting tested for sickle cell trait but does not include why this could adversely affect a student athlete.	The advantages are incorrect or missing.
Persuasiveness	While the infographic conveys information both for and against genetic testing, it clearly takes a stand and presents information in an intentional manner that seeks to convince the viewer to take a certain side.	While the infographic conveys information both for and against genetic testing, it does take a side. However, the stance that it takes may not be immediately clear.	It is not clear if the infographic is attempting to persuade viewers.
Presentation	The information is presented in a clear, logical, and visually appealing manner.	The information is presented in a somewhat clear, logical and visually appealing manner but improvements could be made in several areas.	The way in which the information is presented is confusing and not visually appealing.