**Introduction to Hemoglobin and Sickle cell:**

**A classroom scene with activity/discussion suggestions**

*Alex:* Seems like we need to review some biology and chemistry to really get this. Does anybody remember what the causes of sickle cell are? I seem to remember from intro bio that it is caused by a single mutation in the gene that produces hemoglobin?

*Beatrice:* And hemoglobin is the oxygen-transporting protein of red blood cells. I remember that it has four polypeptide subunits; 2 alpha chains and two beta chains. My bio teacher said that Hemoglobin changes shape when it binds oxygen and that the amount it can hold varies with pH. That’s why it picks up oxygen in the lungs and dumps it in the muscles.

*Charlie:* Yes! We did a unit in my AP Bio class on hemoglobin and on mutations. I think sickle cell is caused by one amino acid change in one of the subunits.

*Dorothy:* Really? One little amino acid change and then it can’t bind oxygen properly? How does that work?

*Charlie:* So, it makes a valine instead of a glutamate at this one position. Maybe that affects the shape of the molecule? We saw this cool animation in my high school class that shows how the mutation changes the shape. Here, let me show you. It’s on YouTube.

 <https://www.youtube.com/watch?v=Y66B7PWrE00&feature=youtu.be>

*Eliza:* I read that there’s lots of people, especially in tropical areas that carry that mutation, or something similar. I think its related to protection from malaria.

*Farah:* Yeah. I remember I did this study for my freshman seminar. There is a cool video about how Tony Alison figured out the relationship between sickle cell disease and Malaria. We should watch you know <https://www.hhmi.org/biointeractive/making-fittest-natural-selection-humans>. Sickle cell disease affects millions of people worldwide. It is most common among people whose ancestors come from Africa; Mediterranean countries such as Greece, Turkey, and Italy; the Arabian Peninsula; India; and Spanish-speaking regions in South America, Central America, and parts of the Caribbean.

*George:* I remember my friend has an aunt, Melissa Creary, who helped develop the sickle cell program at CDC. She also studied communities in Brazil with high prevalence of sickle cell trait. Now she teaches at the University of Michigan. Here, I found her contact information online, (<https://sph.umich.edu/faculty-profiles/creary-melissa.html>). Perhaps we can ask her some questions.

For the next 10-15 minutes, explore the links listed above and other relevant sources to gather information about hemoglobin and sickle cell disease:

<https://en.wikibooks.org/wiki/Structural_Biochemistry/Hemoglobin>

<https://ghr.nlm.nih.gov/condition/sickle-cell-disease>

<https://www.hhmi.org/biointeractive/sickle-cell-disease>

You may also consult some of the options listed in the resources page and discuss with your groups as needed.

**Activity/Discussion**

Answer the following questions in a few sentences each:

1. Describe the composition and overall structure of hemoglobin. Why is it so important for us?
2. How does sickle cell hemoglobin (HbS) in red blood cells cause them to sickle?
3. How does the sickling of red blood cells cause anemia, a shortage of red blood cells?