

SECTION 1 - Pre-Laboratory Classroom Activity

The objectives of the classroom activity are:

- Observe normal and sickle cell photos
- Imitate the movement of blood cells to gather data and make inferences about sickle cell anemia
- Analyze an inheritance pattern using a pedigree
- Work cooperatively to explain the symptoms exhibited in sickle cell anemia
- Construct an explanation of the disease mechanism

Materials

Yellow and orange RUNTS[®] candy (available in grocery stores)
Photos of normal and sickle cells (an excellent photo showing both side-by-side can be found at <http://www.urmc.rochester.edu/genetics/brochures/sc.htm>)
Patient Description
Sheets A, B & C for each student group
Two bottles (clear Worcestershire or hot sauce bottles with long, skinny necks work well)
Copies of Patient Description and Sheets A, B & C for each student group

Engage (15 min)

Organize the students in groups of four. Have each team read a description of the patient who came to Dr. Herrick, a Chicago physician, in 1904 (see the Patient Description File). The essential question is “What is the mechanism of the disease?” Instruct the students to make observations and gather clues about the condition described in the patient scenario. Ask the students to identify and underline any clues in the description that may help them determine the effect of the disease on the patient.

When they are finished, invite a student from each team to write two clues on the board. Discuss the clues as a class. Ask for clarification or expansion of ideas where appropriate. Encourage the students to think freely and make connections based on the evidence given in the patient description as well as on their own experience. The discussion usually leads to many good ideas about the mechanism of the disease. However, the students soon determine that they need to explore the disease in greater depth in order to substantiate their ideas and gain a deeper understanding of the disease.

Explore (20 – 30 min)

To assist the student in their investigation, set-up multiples of the three stations below (enough for groups of four students to work at one time). Each station is comprised of materials that in some way model or illustrate concepts relating to the mechanism of the disease. Give each team descriptions of the stations (see the Station Sheets) that include directions that encourage exploration. Urge the students to gather observations that may yield insights to the mechanism of the disease. It is helpful to assign the roles of “reader” and “recorder” at each station to facilitate cooperation among team members. Rotate the teams through both stations allowing about 5 - 10 minutes per station.

Set-up each station as follows:

Station A Copies of pictures of sickle cell blood and normal blood - At this station the students will observe the photos and pick-out the differences between the two cells (students should notice that the sickle shape cells look differently than the round normal cells and that there are fewer blood cells causing anemia).

Station B Three empty bottles labeled AA, AS and SS, yellow and orange RUNTS[®] At this station students will add the orange candy to one bottle and the yellow candy to the other. Have the students try to slowly pour the candy out of each bottle and observe how they flow out of the bottles. The orange candy should flow easily and the yellow candy should clog in the neck (because of their sickle shape).

Station C Pedigree and pedigree symbol key (see Station A Sheet) - At this station, students will analyze the inheritance pattern of the disease (and should note that it appears to be hereditary).

Explanation (10 – 15 min)

After all of the groups have rotated through the stations, ask the members of the teams to regroup and synthesize an explanation of the mechanism of the disease. Next, ask teams to present their explanations to the entire class. Encourage students to be creative in their presentations by giving them the option to present verbally, in writing, with diagrams or concept maps, or by using role-play. Students often generate many ideas and interesting topics for discussion. Encourage the students to debate their ideas and consider them in light of the observations they made. The discussion frequently becomes lively with considerable student-student dialogue. Challenge and elaborate on students' ideas to lead them to discover the following points:

- The blood cells are irregularly shaped
- The irregular shape of the red blood cells interferes with their ability to flow through the blood pathways
- The condition is inherited

Refer to the stations to assist the students' discovery of the above points. Demonstrate the cause of sickling using the models from station B. The blockage created by the sickle cells is illustrated in Station B while the photos from Station C indicate anemia and irregularly shaped red blood cells. The family history suggests the possibility that the condition is inherited. At this point, the students are usually curious about the name of the disease. Let them generate their own name for the condition based on their understanding of it and emphasize that their name is just as valid as the name given by Dr. Herrick. He based the name on his observations of sickle shaped cells and the decrease in the number of red blood cells, or anemia.

Patient Description

In 1904, a student from the West Indies came to a Chicago Physician, Dr. James Herrick, with a puzzling condition. Below is a summary of some of the observations Dr. Herrick made. Your job is to learn more about this condition and to find out how the disease affects the body. Read the description below and underline the information that you think may provide important clues that will help you understand the disease.

Dear Colleague:

The patient reports feeling well most of the time. But he also reports odd reoccurring events. For instance, one day after a short swim he became so tired that he could hardly move. He became short of breath and complained of pain in his joints and muscles, especially the arms and legs. He felt unusually weak and required bed rest lasting a few weeks. These symptoms occurred repeatedly during his youth. He also had frequent fevers and infections.

The patient complained of fatigue and soreness in the joints. Upon inspection, the whites of his eyes had a yellowish tint. He complained of pain in the left abdominal area, which was tender to the touch.

A family history reveals that he has two brothers and three sisters. None of them have this condition. His uncle and his grandmother often had similar symptoms. His grandmother died a young woman. His parents do not have this condition.

Your medical opinion in understanding this disease is appreciated.

James Herrick, M.D.

Recorder _____

Reader _____

Station A

At this station you will observe photographs of blood samples. The photo marked P represents the patient's blood sample. The photo marked N represents a normal blood sample.

Describe (in writing or pictures) the differences you see between the two blood samples.

Recorder _____

Reader _____

Station B

The bottles at this station represent the pathways of blood in the body. Models representing the patient's red blood cells and normal red blood cells are also given. Red blood cells must flow freely through the body in order for the blood to do its job of delivering oxygen and picking up wastes, such as carbon dioxide.

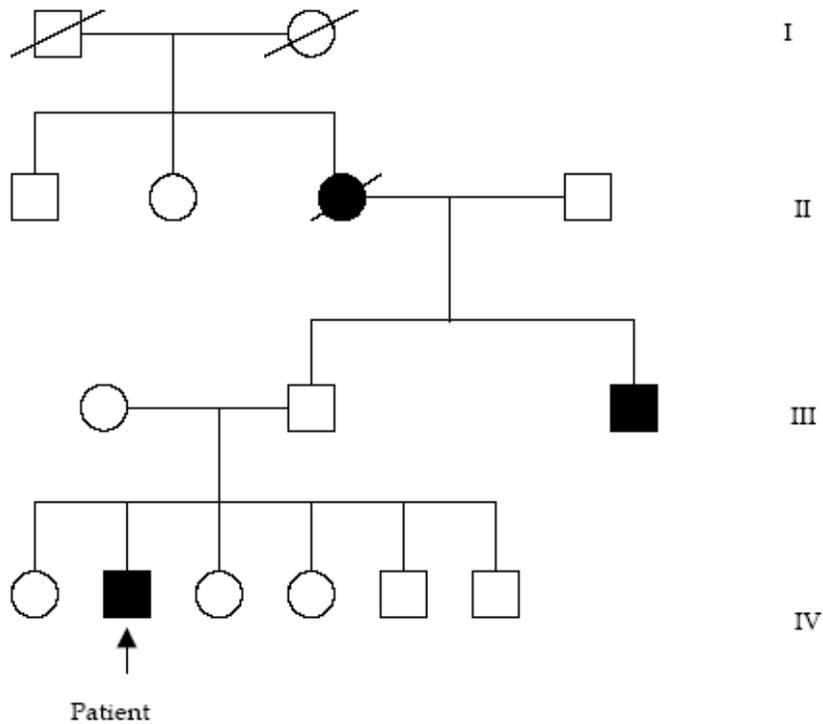
Place the orange red blood cells (normal) into one bottle and the yellow red blood cells (patient's) into the other. Slowly turn the bottle upside down and observe the blood cells as they flow through the neck of the bottle. Use these models to show the effect the patient's red blood cells will have on the flow of blood.

Recorder _____

Reader _____

Station C

Based on the family history given below, how do you think the patient got the disease? Record your answer on the back or this page.



Key to symbols

Male	Female	Deceased
Male affected	Female affected	Parents
Offspring		