

- in high altitude on hike and in Mexico City (decreased  $O_2$  and poor air quality)

- diarrhea

- strenuous exercise

- syncope (pass out)

- muscle cramping in leg and abdomen

- disorientation

- shallow breathing rapid

- took small amounts of saline during night for sickness

- high hematocrit

Low pH  
~~• how does low~~

- low potassium levels

- possessed one → two unusual red blood cells

- dehydration from diarrhea

- epidemic from fungus spreading through the US

- ancestry: Italian

- does NOT have malaria

• how does low pH affect the body?

• does muscle cramping have to do with lack of  $O_2$ ?  
↳ why does this cause the cramping

• are there any hem-  
atocrit levels that are too high?

• what causes the ✓  
red blood cells to  
change from normal  
to sickle trait?

• how/can sickle RBC  
change back to  
normal shape?

• what causes the pH  
to lower ✓

• how do low  $K^+$   
levels affect the  
body & what are  
their symptoms

• what causes  
hematocrit  
hemoglobin levels to  
stop increasing (certain  
point/ratio = shut off)  
?

• how much oxygen  
can a sickled RBC  
hold (if any)?

• how does the body  
respond to an acidic  
blood pH ✓

• what are some  
major life threatening  
symptoms of sickle  
trait?

• what makes normal  
hemoglobin and  
sickle hemoglobin  
different?

• what is the difference  
b/w sickle cell trait  
and sickle cell disease?  
✓

• why was saline  
(w salt that dehydrates)  
given to Maria after  
she was dehydrated  
from diarrhea?

• what happens on  
the molecular level  
to cause normal  
hemoglobin to become  
sickled hemoglobin?

• what reason was  
saline given to  
reduce Maria's sickness

A low pH causes the body to be more acidic than usual. This can cause some of our bodies functions (ie. enzymes...) to no longer be able to work in the acidic environment. With this many necessary tasks can no longer be performed and our body may start to shut down depending on severity and duration of the acidic state.

tered-states.gov.

The pH lowering in the body can be from the over production of hydrogen ions ( $H^+$ ) or the inability to produce ~~bicarbonate~~ ( $OH^-$ ) hydroxide. Also from lack of correction reactions (blood buffers) to try and stabilize pH can cause it to lower, or if excess acid is added.

www.anesthesia.med.edu.au.

(rise of acidic concentration)

- The body responds to low pH in the blood with blood buffers. These include carbonic-acid-bicarbonate.
- They will bind  $H^+$  to them to make new compounds and remove some acidity. The chemical formula can be reversed in high pH.

chemistry.edu

The difference between sickle cell trait and sickle cell disease is... (from article)

Sickle Trait	Sickle Disease
<ul style="list-style-type: none"> <li>• inherited 1 gene (autosomal recessive)</li> <li>• usually doesn't show symptoms</li> <li>• has normal &amp; morphing sickle RBCs.</li> <li>• RBC are soluble @ lungs at bind to <math>O_2</math></li> <li>• transfers gases very well comparatively.</li> </ul>	<ul style="list-style-type: none"> <li>• inherited 2 genes (autosomal recessive)</li> <li>• all blood cells are sickled.</li> <li>• life is always at risk</li> <li>• can have lung, liver scarring because RBC don't bind as easily to <math>O_2</math></li> <li>• not soluble → deprives tissues of oxygen</li> </ul>

• Sickle cells change from being normal due to a mutation (in position 6) on the amino acid DNA.

NORMAL	SICKLED
glutamic acid in p. 6	valine component in p. 6

This causes the bioncave shape (pliable and soft) to become an abnormal crescent shape (rigid).

here is why...

• how severe/small is the amino acid mutation? - very small.

• If you wait the RBC mutation for certain conditions of stress and strenuous exercise cause  $O_2$  levels are low **back** due to the mutation @ p. 6 Maria's hemoglobin protein molecules had a mutation in p. 6 causing the polar R group to become non-polar. This changes the shape because the hydrophobic section will disrupt other inter-molecular bonds and group w/ other hydrophobic sections within that protein. The hydrophobic clump attracts other hemoglobin to attach until there is a long rod of hydrophobic groups in the RBC. This causes the sickle shape.

The RBC sickle shape cannot pass through the capillaries due to the abnormal structure and deprives tissues of  $O_2$ . This is why Maria developed muscle cramping, for example.

The cramping was due to lack of  $O_2$  and inadequate blood supply. Also too little potassium and other minerals. (from lack of blood flow)

mayoclinic.org

- some symptoms of sickle trait are muscle cramping, dehydration, trouble/shallow breathing.

Possibility of blood building up in spleen and liver.

This is due for most symptoms to the abnormal crescent shape of RBC from sickle cell disease or (Maria's) sickle trait.

• what causes the RBC to build up in these places?

Maria's RBC can hold just as much  $O_2$  and is the same solubility at the lungs. The hemoglobin can store the usual 4  $O_2$  molecules, but the body is being deprived of  $O_2$  because the sickle cells cannot pass into capillaries to deliver the  $O_2$ . Maria then developed muscle cramping, disorientation, shallow & rapid breathing. In attempt to fix the lack of normal biconcave RBCs, the hematocrit levels increase ~~to attempt~~. Maria has sickle trait, so she still has some normal RBC.