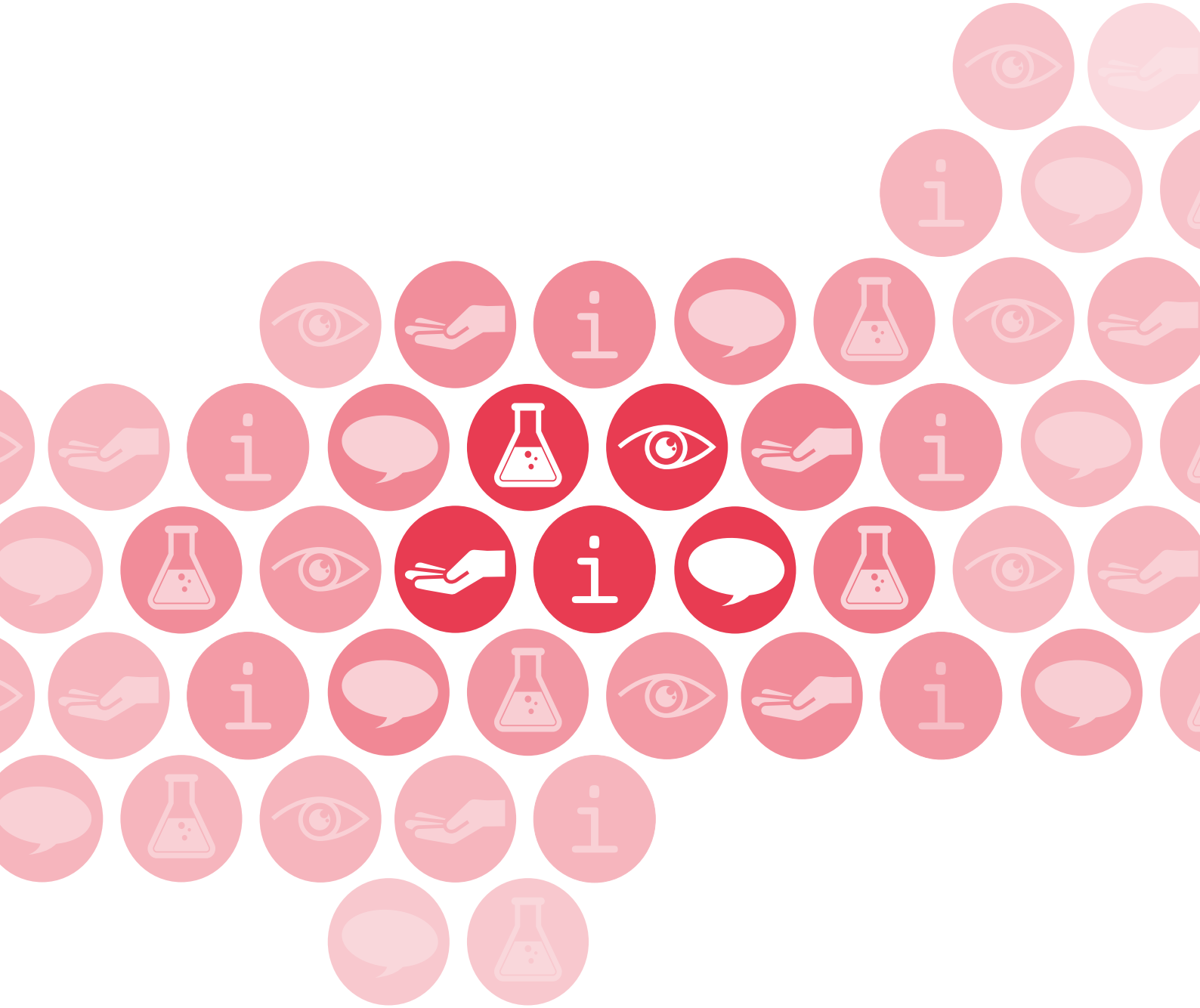
The Royal College of Pathologists
Pathology: the science behind the cure



RED BLOOD CELL MODELLING
RESOURCE PACK

Introduction

You can make your own red blood cell models using air-drying or oven-baked clay. Instructions on how to make normal red blood cells and the 'sickle-shaped' red blood cells that are formed when someone has sickle cell are below.

You can buy air-drying clay from online suppliers such as Amazon (for example this **clay**) and Katy Sue Designs; see: **https://katysuedesigns.com/collections/clay**. You can also try and make your own clay at home. Here are two options:

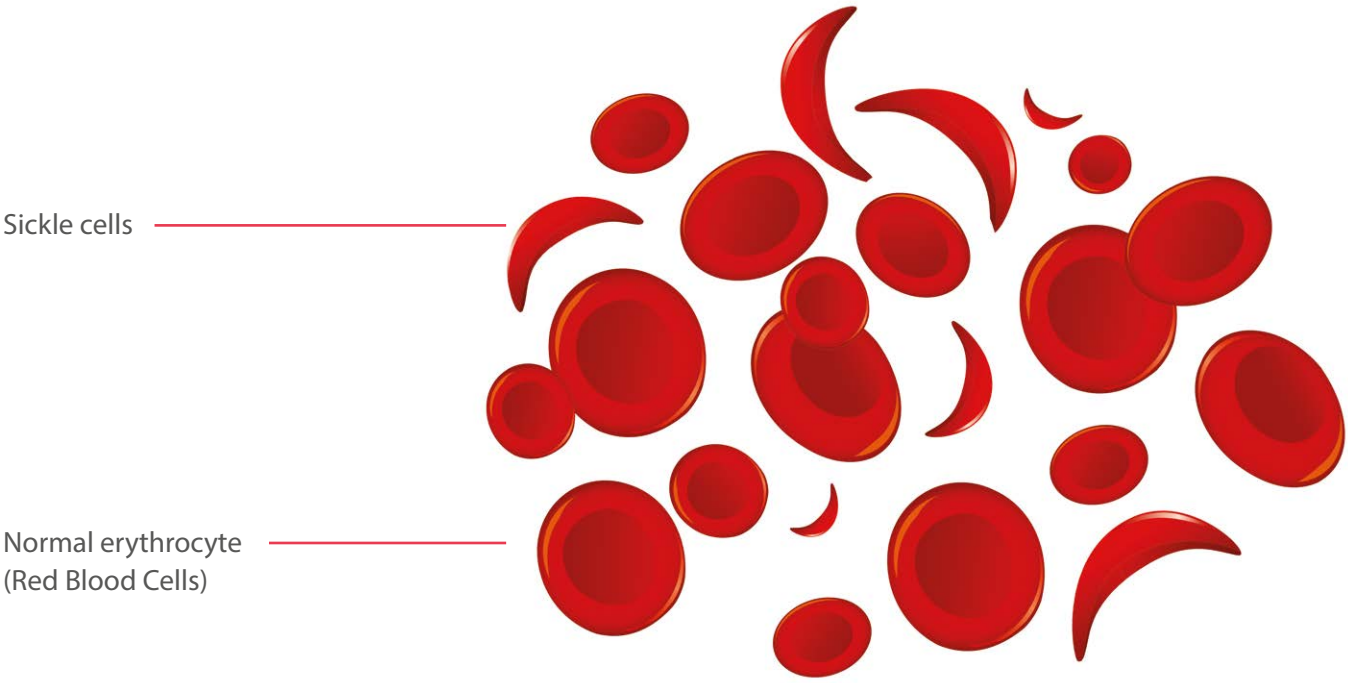
1. This clay is made in the microwave, is air-drying and uses PVA glue: **https://youtu.be/drZc68lSwxY**

2. This clay is salt dough and you need to bake to harden: **https://www.youtube.com/watch?v=L7sH9bj-fl0**

You will need red, white and blue clay.

A bit about red blood cells and sickle cell disorder

Red blood cells are disc-shaped cells in the blood that carry oxygen to all parts of the body. This enables all of the cells in the body to carry out respiration. Haemoglobin is the protein present in red blood cells that oxygen molecules bind to.



People with sickle cell disorder have red blood cells that are not shaped like discs but are instead sickle-shaped. They also have abnormal haemoglobin meaning oxygen cannot bind as efficiently.

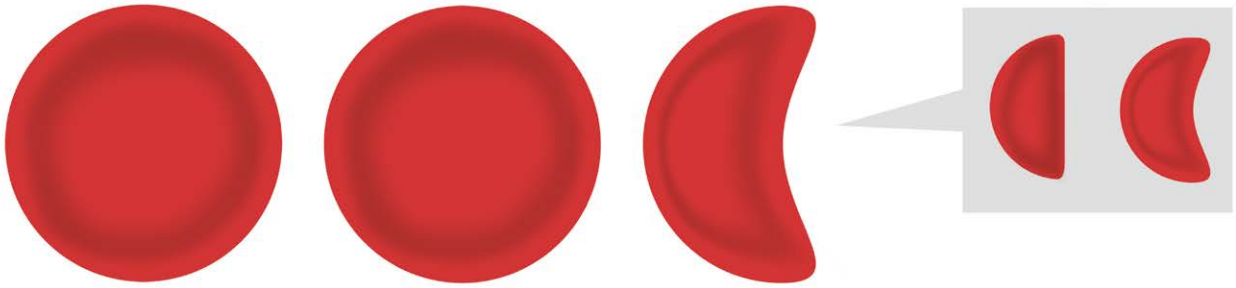
Use the air-drying clay to make one normal red blood cell and one sickle-shaped red blood cell each. Look at the diagrams below and follow the photo instructions to make your blood cells.

How to make your red blood cells out of modelling clay:

Work in pairs – you will make one normal red blood cell and one sickle cell each but you need to work in pairs to make economical use of the clay.

Step 1

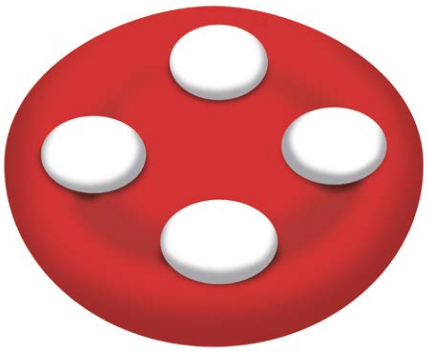
In your pair make three balls approximately 3-4cm in diameter out of the red clay. Squash each ball into a disc of around 6 - 7cm in diameter and then use your thumb to create a concave in the centre of each. Two of these are now normal red blood cells; the other will be divided into two sickle cell-shaped blood cells. Use scissors to cut the third disc in half exactly then shape each half in to a sickle cell as shown in the photo below.



Step 2

In your pairs make 12 small balls (around 0.5cm diameter) out of the white clay. Press each of these into flat discs that are about 1.5cm diameter. These represent haemoglobin molecules, which are the proteins found in red blood cells that carry oxygen.

Attach these 'haemoglobin discs' to your blood cells. There should be four on each – note that in reality each human red blood cell contains approximately 270 million of these haemoglobin molecules! On the normal red blood cell space them out evenly as shown below.

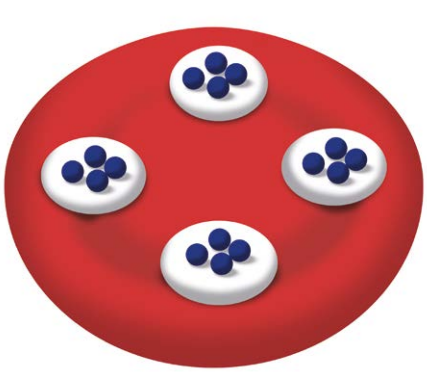


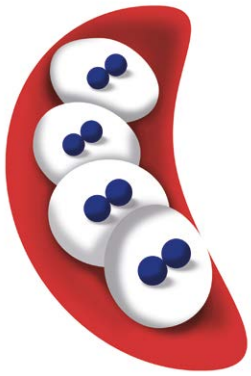
Place them in an overlapping line on the sickle blood cell. This represents how haemoglobin molecules in sickle cells interact with each other and crystallise, a process that reduces the ability of sickle cell haemoglobin to carry oxygen.

Place the white discs in an overlapping line on the sickle blood cell

Step 3

Now make some very tiny blue clay balls to represent molecules of oxygen. You need 16 for each normal red blood cell model and eight for each sickle cell. Now place these on to the white discs as shown below (four per disc on normal red blood cell and two per disc on sickle red blood cells). This represents the reduced capacity of haemoglobin in sickle red blood cells to carry oxygen compared to normal red blood cells. Remember this is only a representation and does not indicate the true number of oxygen molecules that are carried by human red blood cells!

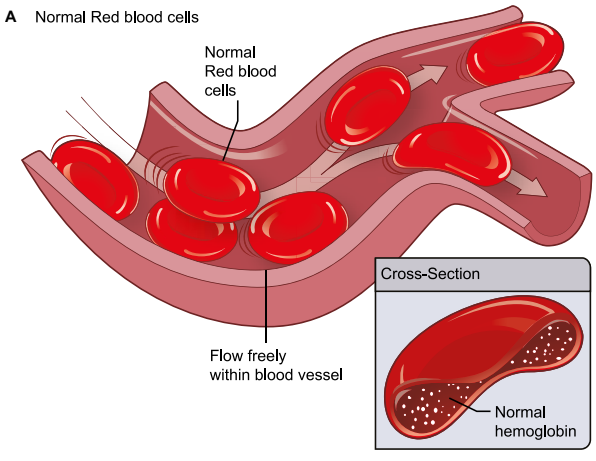


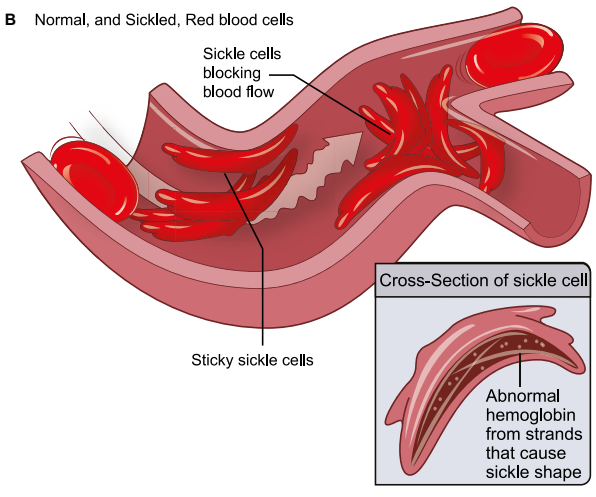


You should now have one disc-shaped 'normal' red blood cell and one sickle-shaped each. You now have a visual reminder of the key differences in structure and function between normal and sickle red blood cells.

Facts

- Red blood cells are also known as 'erythrocytes'
- Red blood cells do not have a nucleus and are packed with haemoglobin, a protein that contains iron
- Haemoglobin carries oxygen from the lungs to the rest of the body
- Everyone has two copies of the gene for haemoglobin; one from their mother and one from their father. Sickle cell disorder occurs when a person inherits two abnormal copies of the β-globin gene that makes haemoglobin, one from each parent.
- Abnormal haemoglobin forms strands inside red blood cells and this is what makes them sickle-shaped instead of disc-shaped.
- Abnormal haemoglobin cannot carry as much oxygen as normal haemoglobin, reducing the transport of oxygen to the tissues and cells of the body.





- The shape of sickle blood cells reduces normal blood flow to cells and organs of the body because they stick to the walls and cannot squeeze through the capillaries. Blood flow through tiny blood vessels slows or stops in many parts of the body. This deprives tissues and organs of oxygen, leading to painful symptoms.
- Sickle cell disease affects around one in 2000 babies born in the UK.

Read more about sickle cell disorder via the links below:

https://ib.bioninja.com.au/standard-level/topic-3-genetics/31-genes/mutations.html

https://www.sicklecellsociety.org/resource/sickle-cell-anaemia/