Name: ______________________________________ Period: _________ Date: ________

# Specialized Cells in Blood and Bone Marrow

Human blood has three basic cellular components: **white blood cells (WBC)**, **platelets**, and **red blood cells (RBC)**. As Figure 1 shows, these three components are produced almost exclusively from stem cells which are found in the bone marrow, primarily of ribs, vertebrae, the sternum, and pelvis.

There are several types of WBCs: monocytes, granulocytes, and lymphocytes. WBC are part of the immune system, so they contribute in various ways to fighting disease agents and other invaders of the body. Platelets are actually fragments of cells, and are involved in the formation of clots. RBCs are atypical cells highly specialized for transporting $O_2$. They make it possible for all cells of the body to receive the continuous supply of $O_2$ they need for cellular respiration. RBCs are unusual in that they lack a nucleus and most other organelles typically found in cells. They are essentially nothing more than membranous sacks filled with **hemoglobin (Hb),** a unique protein that makes it possible for them to do their vital job.

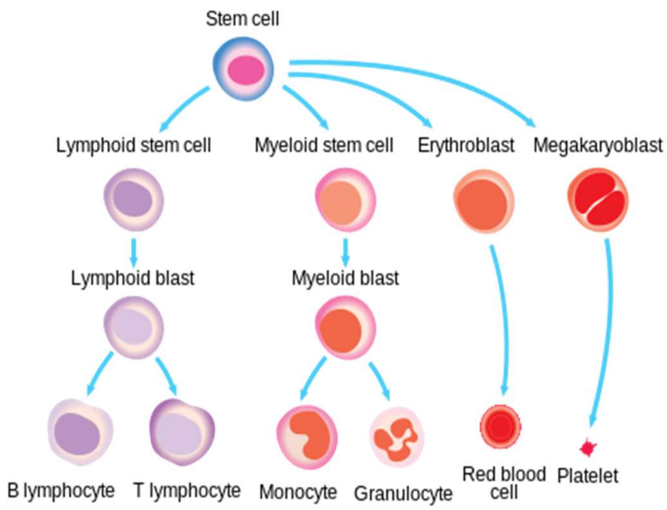


**Fig. 1** Blood cells form in bone marrow from stem cells.
https://commons.wikimedia.org/wiki/File:Diagram_showing_how_blood_cells_are_made_CRUK_125.svg

## Proteins in Marrow and Blood Cells

Of the nearly 20,000 different types of protein found in the human body, 12,877 are found in bone marrow and the blood cells produced there. Almost all of these are found in varying amounts in other cells of the body, but 29 of them are considered **"enriched"**, meaning they are found in ***much*** greater amounts in marrow and blood cells than other body cells. The enriched proteins account for many of the specific features and functions of these specialized cells. Hemoglobin, the protein that fills our oxygen-carrying RBCs, is one of these important enriched proteins.

It is the unique structure of hemoglobin that gives it the ability to bind, carry, and release $O_2$. Hemoglobin molecules are made up of four subunits (two called *alphas,* and two *betas*), each of which contains one **iron (Fe)** atom. Significantly, iron is an element that reacts readily with $O_2$. When RBC's are in the lungs where the concentration of $O_2$ is high, each Fe atom bonds temporarily to an $O_2$ molecule. The RBC then travels through the blood stream, carrying the $O_2$ to the body tissues, where the concentration of $O_2$ is low. When in areas of low oxygen concentration, the $O_2$ separates from the Fe, making it available to the cells in that area that need it. After releasing their $O_2$, RBCs continue through the bloodstream until they get back to the lungs where they pick up more $O_2$ and the process repeats. The hemoglobin in our RBCs vastly increases the $O_2$ carrying capacity of our blood, enabling it to transport 70 times more $O_2$ than it otherwise could.

Hemoglobin is such a large, complex molecule that multiple genes are involved in its production. There are two genes for the alpha subunit on chromosome 16, and five for the beta subunit on chromosome 11.

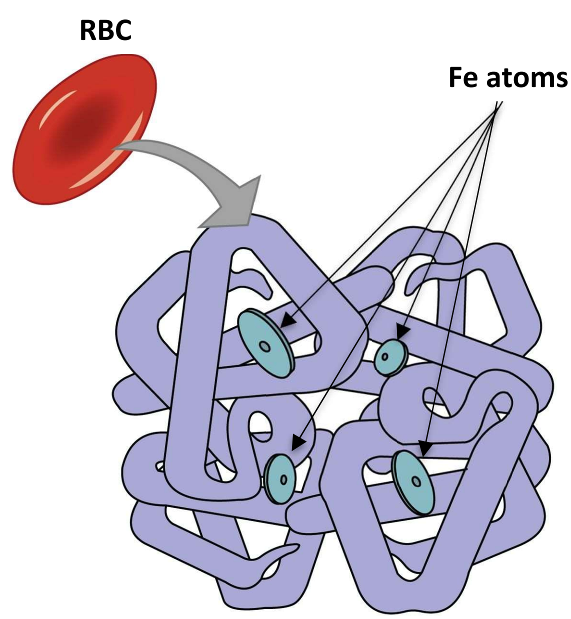


**Fig. 2 HEMOGLOBIN molecule** with alpha and beta subunits. Note four Fe (iron) atoms.
https://commons.wikimedia.org/wiki/File:2322_Fig_23.22-a.jpg