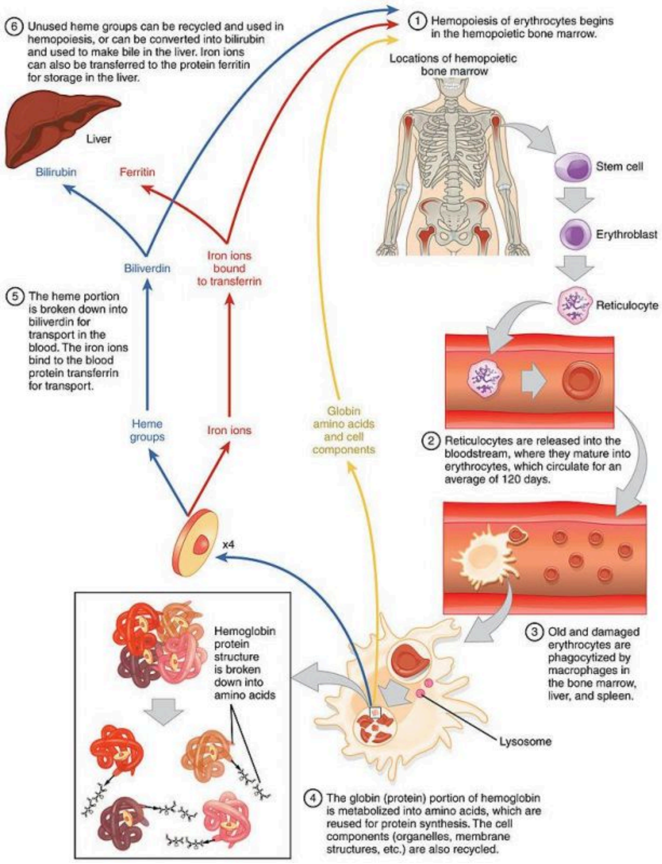
2.1.7

Breaking Down Red Blood Cells

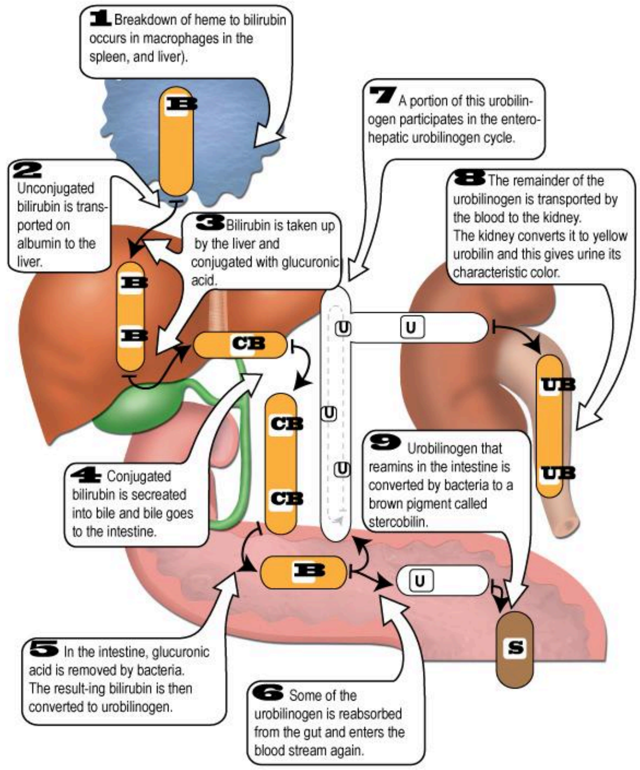


Life-cycle of an Erythrocyte.

File: 1905 Erythrocyte Life Cycle.jpg; Author: OpenStax College; Site: https://commons.wikimedia.org/wiki/File:1905_Erythrocyte_Life_Cycle.jpg;License: licensed under the Creative Commons Attribution 3.0 Unported license

Owing to their inability to produce their own proteins and structural components (no nucleus/ribosomes), erythrocytes have a limited circulatory lifespan of around 120 days. Therefore, erythropoiesis must occur constantly in order to meet the demands of the human body. As stated previously, over two million red blood cells are produced each second suggesting that the number of red blood cells that die each second is also in the millions. Specific mechanisms must be in place to deal with the disposal of so many red blood cells.

White blood cells known as **macrophages** find the dying blood cells and then engulf them and start to digest them (sounds like a horror movie!). Enzymes within the macrophages degrade the globin hemoglobin chains into amino acid monomers, while the heme groups are split into iron atoms and a compound known as **biliverdin.** The degraded parts (amino acids, heme, and biliverdin) are then secreted from the macrophage back into the blood. The iron binds to a protein known as **transferrin** and is transported to the red bone marrow to be reused for further red blood cell production. Biliverdin is converted to **bilirubin** and is released into the bloodstream where it binds to albumin proteins for transport to the liver. Amino acids, since they are major building blocks, are transported in the blood and either taken up by other cells or reused by the bone marrow.



Recycling of Red Blood Cells.

Image drawn by BYU-Idaho student Nate Shoemaker Spring 2016

Bilirubin traveling through the blood to the liver is known as **free bilirubin.** Liver cells collect free bilirubin and bind a molecule called glucuronic acid to it. Bilirubin is then called **conjugated bilirubin.** Glucuronic acid adds polar groups which makes bilirubin water soluble. Conjugated bilirubin becomes a component of **bile,** which will be secreted from the liver into the digestive tract. Once in the digestive tract, glucuronic acid residues are removed and bilirubin is converted to urobilinogen. Urobilinogen can re-enter the blood circulation and cycle back to the liver for another pass into the digestive tract as conjugated bilirubin (called the enterohepatic urobilinogen cycle), or it can be filtered in the kidney where it is converted to urobilin which is yellow in color and contributes to the color of urine. Urobilinogen that does not re-enter the blood circulation from the intestines will be converted to stercobilin, which is dark brown in color. This contributes to the color of feces.

Jaundice is a condition characterized by the buildup of excessive bilirubin in the blood that causes the skin and whites of the eyes to take on a yellowish tinge. Any condition resulting in excessive destruction of red blood cells can cause jaundice. Also, any condition that decreases the conjugation and excretion of bilirubin can also cause jaundice. Jaundice is particularly common in newborn infants because their immature liver may not be able to produce enough enzymes to conjugate it all. If left untreated, excess bilirubin can damage an infant's developing brain. However, this condition can be treated by exposing an infant's skin to ultraviolet radiation which helps break some bonds on the bilirubin molecules making them more water soluble and easier for the liver to excrete.