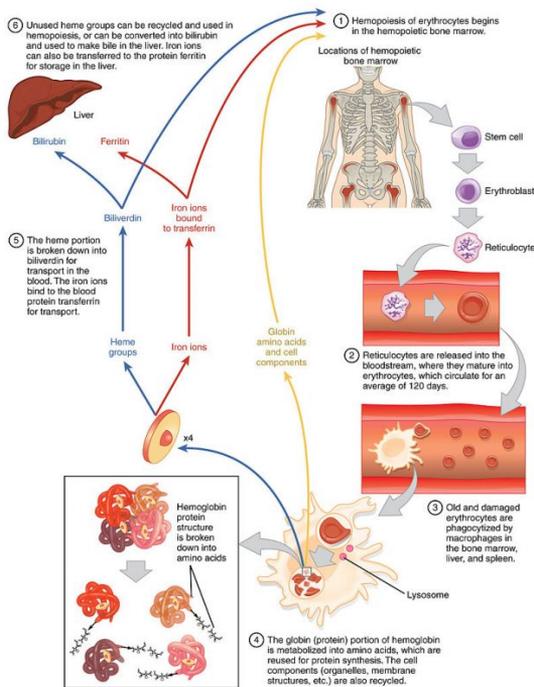


3.6.3

Breaking Down Red Blood Cells



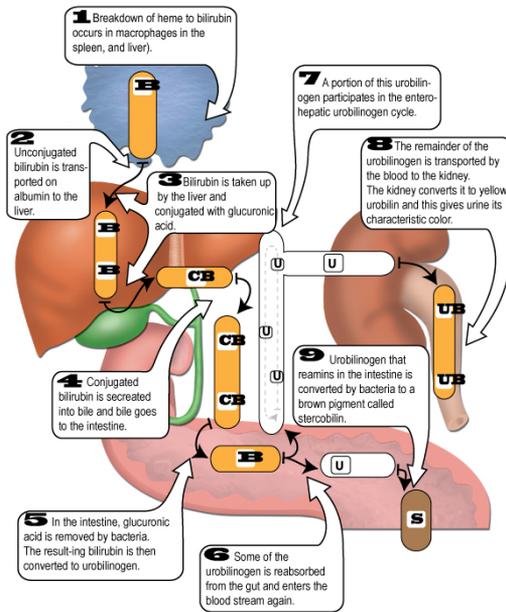
Life-cycle of an Erythrocyte

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, 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.

If over two million red blood cells are produced each second and the number of red blood cells in the body remains within a normal range, then the number of red blood cells that die each second must be astounding as well. Specific mechanisms must be in place to deal with the disposal of so many red blood cells.

White blood cells known as **macrophages**, contained within the bone marrow, liver and spleen, perform the initial processing of damaged erythrocytes. Enzymes within the macrophages degrade the globin polypeptide hemoglobin chains into amino acid monomers while the heme groups are split into iron atoms and a compound known as **biliverdin**. The iron binds to a protein known as **transferrin** which transports it through the blood stream to the red bone marrow, thus making it available for further red blood cell production. Biliverdin is converted to **bilirubin** and is released into the blood stream where it binds to albumin proteins for transport to the liver.



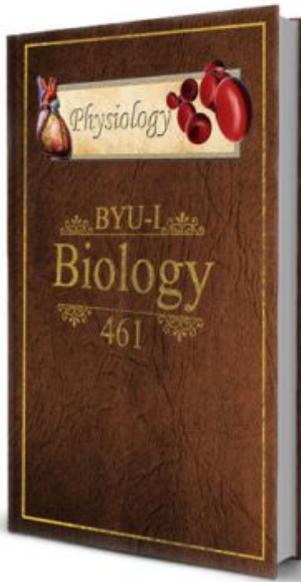
Recycling of Red Blood Cells

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 lends polar groups and water solubility to the generally insoluble free bilirubin. 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 of a certain enzyme which participates in the conversion of bilirubin to bile. 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 which make them more water soluble and easier for the liver to excrete.



Shaw, J. & Hunt, J. (n.d.). *BIO 461 Principles of Physiology*. EdTech Books.
https://edtechbooks.org/bio_461_principles_o