HEMOGLOBIN UG/SEM 4/SDG

Hemoglobin is a two-way respiratory carrier, transporting oxygen from the lungs to the tissues and facilitating the return transport of carbon dioxide. In the arterial circulation, hemoglobin has a high affinity for oxygen and a low affinity for carbon dioxide, organic phosphates, and hydrogen and chloride ions. In the venous circulation, these relative affinities are reversed. To stress these remarkable properties, Jacques Monod conferred on hemoglobin the title of “honorary enzyme.”

STRUCTURE OF HEMOGLOBIN

Hemoglobin comprises four subunits, each having one polypeptide chain and one hemegroup .

All hemoglobins carry the same prosthetic heme group iron protoporphyrin IX associated with a polypeptide chain of 141 (alpha) and 146 (beta) amino acid residues.

The ferrous ion of the heme is linked to the N of a histidine. The porphyrin ring is wedged into its pocket by a phenylalanine of its polypeptide chain.

The polypeptide chains of adult hemoglobin themselves are of two kinds, known as alpha and beta chains, similar in length but differing in amino acid sequence.

The sixth coordination position is available for binding with oxygen and other small molecules.

Called oxyhemoglobin, HbO2 in the oxygenated form and carboxyhemoglobin, HbCO, when the oxygen is displaced by carbon monoxide.

Binds reversibly with oxygen while the heme iron remains in the ferrous state.

The alpha chain of all human hemoglobins, embryonic and adult, is the same. The non-alpha chains include the beta chain of normal adult hemoglobin ($\alpha 2\beta 2$), the gamma chain of fetal hemoglobin ($\alpha 2\beta 2$), and the delta chain of HbA2. In some variants, the gamma genes are duplicated, giving rise to two kinds of gamma chains.

In human hemoglobin, the fit between the polypeptide chain is critical because the gap between two of the polypeptide chains in the hemoglobin molecule becomes narrower when oxygen molecules become attached to the ferrous atoms.

Mammalian hemoglobins have molecular weights of about 64,500.

Autoxidation is prevented by the cover of hydrophobic groups of the globin.

When the iron in hemoglobin is oxidized from the ferrous to the ferric state the compound is called methemoglobin and is accompained by loss of oxygen-binding capacity.

Oxygen binds reversibly to the ferrous iron atom in each heme group.

The heme group that has become oxygen bound varies with the partial pressure of oxygen.The sigmoid shape of the oxygen equilibrium curve shows that there is cooperative interaction between oxygen binding sites. Hence, as oxygenation proceeds, combination with further molecules of oxygen is made easier.

The structure of hemoglobin has been extensively studied by x-ray analysis. The arrangement of the subunits—which is known as the quaternary structure—differs in the oxy- and deoxyhemoglobin.

WHAT ARE THE NORMAL RANGES OF HEMOGLOBIN IN HUMANS?

- For females the normal range for hemoglobin is : 11.5-15.5 g/dl
- For males the normal range for hemoglobin is : 13.5-17.5 g/dl

FUNCTIONS OF HEMOGLOBIN

- IMPARTS RED COLOUR TO THE BLOOD
- FACILITATES OXYGEN TRANSPORT
- FACILITATES CARBONDIOXIDE TRANSPORT
- BUFFERS BLOOD pH AND MAINTAINS ITS TOLERABLE LIMITS
- SOURCE OF PHYSIOLOGICAL ACTIVE METABOLITES
- TRANSPORTS NO

BLOOD GROUPS

Blood groups were discovered in 1901 by an Austrian scientist named Karl Landsteiner. Before that, doctors thought all blood was the same, so many people were dying from blood transfusions.

Blood types are determined by the presence or absence of certain antigens – substances that can trigger an immune response if they are foreign to the body. Since some antigens can trigger a patient's immune system to attack the transfused blood, safe blood transfusions depend on careful blood typing and cross-matching.

There are four major blood groups determined by the presence or absence of two antigens – A and B – on the surface of red blood cells. In addition to the A and B antigens, there is a protein called the Rh factor, which can be either present (+) or absent (–), creating the 8 most common blood types (A+, A-, B+, B-, O+, O-, AB+, AB-). There are more than 600 other known antigens, the presence or absence of which creates "rare blood types." Certain blood types are unique to specific ethnic or racial groups. That's why an African-American blood donation may be the best hope for the needs of patients with sickle cell disease, many of whom are of African descent.

- The universal red cell donor has Type O negative blood.
- The universal plasma donor has Type AB blood.

BLOOD TYPES www.homesteadingsurvival.com		
BLOOD TYPE	YOU CAN GIVE BLOOD TO	YOU CAN RECEIVE BLOOD FROM
A+	A+, AB+	A+, A-, O+, O-
O+	O+, A+, B+, AB+	O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+	Everyone
A-	A+, A-, AB+, AB-	A-, O-
O-	Everyone	O-
B-	B+, B-, AB+, AB-	B-, O-
AB-	AB+, AB-	AB-, A-, B-, O-

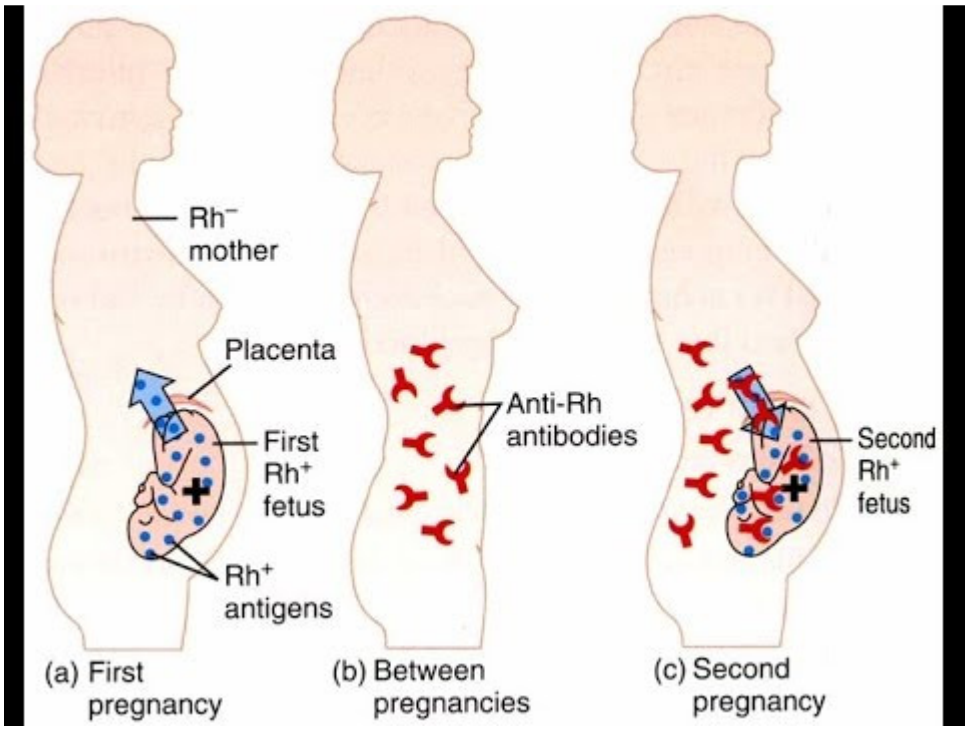
Rhesus (Rh) factoris an inherited protein found on the surface of red blood cells.

- Red blood cells with the antigen are said to be Rh positive (Rh+). Those without the surface antigen are said to be Rh negative (Rh-).
- Blood used in transfusions much match donors for Rh status as well as for ABO blood group, as Rh- patients will develop anemia if given R+ blood.
- Rh typing is also important during abortion, miscarriage, pregnancy, and birth, as mother and fetus may not be Rh-compatible.
- Rh stands for rhesus monkeys, in whose blood this antigen was first found.
- The Rh factor is a specific protein found on the surface of your red blood cells. Rh factor type is inherited from your parents. Most people are Rh-positive, but a small percentage of people are Rh-negative. This means they lack the Rh protein.

When a woman and her unborn baby carry different Rhesus (Rh) protein factors, their condition is called Rh incompatibility. If a woman is Rh-negative and her baby is Rh-positive, then the woman's body will approach the Rh-positive protein as a foreign object, if her immune system is exposed to it. This means that if blood cells from your baby cross your bloodstream, which can happen during pregnancy, labor,

and delivery, your immune system will make antibodies against your baby's red blood cells. This means that your body might send these antibodies across the placenta to attack your baby's red blood cells. takes time for the body to develop antibodies, so firstborn children usually aren't affected but there's a potential for the mother's body to produce antibodies that could be harmful during a subsequent pregnancy.

However, if a mother became sensitized because of a miscarriage or abortion, her first live birth may be affected by Rh incompatibility.



Mother's Rh factor	Father's Rh factor	Baby's Rh factor	Precautions
Rh positive	Rh positive	Rh positive	None
Rh negative	Rh negative	Rh negative	None
Rh positive	Rh negative	Could be Rh positive or Rh negative	None
Rh negative	Rh positive	Could be Rh positive or Rh negative	Rh immune globulin injections

Erythroblastosis fetalisis hemolytic anemia in the fetus (or neonate, as erythroblastosis neonatorum) caused by transplacental transmission of maternal antibodies to fetal red blood cells. The disorder usually results from incompatibility between maternal and fetal blood groups, often Rho(D) antigens.

Erythroblastosis fetalis classically results from Rho(D) incompatibility, which may develop when a woman with Rh-negative blood is impregnated by a man with Rh-positive blood and conceives a fetus with Rh-positive blood, sometimes resulting in hemolysis.