**Plasma proteins**

1. **Blood composition**
* What is a centrifuge used for in a laboratory?

The picture below shows the result of blood centrifugation.



* How many layers are formed when blood sample is centrifuged? Name these layers.
* What blood cells are found in the buffy coat of centrifuged blood?
* What is hematocrit? What percent of blood is hematocrit?
* What is difference between blood and plasma? What is difference between plasma and serum?
1. **Plasma components**
* What are the components of plasma?
* What are 3 types of plasma proteins? How blood plasma proteins are separated into three groups?
* Which organ produces most of the plasma proteins? Which plasma protein is not synthesized in the liver?
* What other components does plasma contain besides water and proteins? List these components. Why are they covered in blood?
1. **Blood proteins**
* Briefly (2-3 sentences about each protein) describe the properties and functions of the following plasma proteins: albumin, gamma globulin, high-density lipoproteins (HDL), low-density lipoproteins (LDL), hemoglobin, transferrin, haptoglobin, ceruloplasmin, fibrinogen, plasmin, thrombin, renin, alpha-1 antitrypsin, C-reactive protein.
* Which of these proteins belong to the alpha globulins? Which of these proteins belong to the beta globulins?
* What protein hormones are in the blood? Why they can be found in the blood?
* What are the acute phase proteins? What are examples of acute phase proteins?
* Match these proteins in the table with their function:

albumin, gamma globulin, HDL, LDL, hemoglobin, transferrin, haptoglobin, ceruloplasmin, fibrinogen, plasmin, thrombin, renin, alpha-1 antitrypsin, C-reactive protein, insulin, cytokines, antithrombin, glucagon.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Function | Transport | Osmotic pressure | Enzyme | Enzyme inhibitor | Regulatory function  | Immune function | Clotting factors  | Fibrinolysis |
| Proteins |  |  |  |  |  |  |  |  |

1. **Pathology**
* What are normal blood protein levels?
* What is hyperproteinemia? What causes high blood protein? What are the symptoms of high protein in blood?
* What is hypoproteinemia? What causes low blood protein? What are the symptoms of deficiency protein in blood?
* What is paraproteinemia?
* What is the dysgammaglobulinemia? What is the Agammaglobulinemia? What happens if immunoglobulins are low?

**Hemoglobin. Heme metabolism. Jaundice.**

1. **Hemoproteins**
* What is chromoprotein?
* What is hemoprotein structure?
* What is heme? Where is heme found?
* What is heme structure? What is porphyrin?
* Name the selected elements in the picture below.

|  |
| --- |
| 1 – 2 – 3 – 4 –5 –  |



* How many bonds can iron form in heme? With which atoms is iron coordinated in heme?
* What are hemoprotein examples? Where are they found in humans? What functions are performed by hemoproteins?

1. **Hemoglobin**
* Name the numbered items in the picture below.

|  |
| --- |
| 1 – 2 – 3 – 4 –5 – 6 –  |



* What are the parts of hemoglobin?
* How many protein subunits are in hemoglobin?
* How many oxygen can one hemoglobin carry**?**
* What is normal hemoglobin? What is abnormal hemoglobin? What disease causes abnormal hemoglobin?
* Describe the forms of hemoglobin:

|  |  |  |  |
| --- | --- | --- | --- |
| Form | What binds to the hemoglobin? | Where this molecule is binds to the hemoglobin? | Function |
| Deoxyhemoglobin |  |  |  |
| Oxyhemoglobin |  |  |  |
| Carbaminohemoglobin |  |  |  |
| Carboxyhemoglobin |  |  |  |

* Can carboxyhemoglobin lead to death?
* What does methemoglobin mean? What is the difference between hemoglobin and methemoglobin? How does methemoglobin affect the blood? Why is methemoglobin bad to organism?
1. **Hemoglobin synthesis**
* Where the protein part is synthesized? Where the heme part is synthesized?
* Which nutrients are required for heme synthesis? Where does heme synthesis begin? How is heme formed?
1. **Heme catabolism**
* Complete the scheme of heme catabolism.



* How many days do erythrocytes live? What happens to erythrocytes after? What organ destroys old red blood cells?
* What happens to the protein part of hemoglobin?
* What happens to the iron that is released during the breakdown of damaged red blood cells?
* What enzyme converts unconjugated bilirubin?

* Describe the two types of bilirubin:

|  |  |  |
| --- | --- | --- |
| Type of bilirubin |  |  |
| Where is this type formed? |  |  |
| Bonded to glucuronic acid (yes/no) |  |  |
| Solubility in water (yes/no) |  |  |
| Have direct reaction with Ehrlich's reagent (yes/no) |  |  |
| Pass through membranes (yes/no) |  |  |
| Excreted by kidneys (yes/no) |  |  |
| Toxic (yes/no) |  |  |

1. **Pathology**
* Fill the tables:

|  |  |  |
| --- | --- | --- |
| **Jaundice type** | **Violation of heme catabolism** | **Causes** |
| Prehepatic/hemolytic |  |  |
| Hepatic/hepatocellular |  |  |
| Posthepatic/cholestatic |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Normal level** | **Prehepatic jaundice** | **Hepatic jaundice** | **Posthepatic jaundice** |
| Total serum bilirubin |  |  |  |  |
| Conjugated bilirubin |  |  |  |  |
| Unconjugated bilirubin |  |  |  |  |
| Alanine transferase and aspartate transferase levels |  |  |  |  |
| Urobilinogen |  |  |  |  |
| Urine color |  |  |  |  |
| Stool color |  |  |  |  |
| Conjugated bilirubin in urine |  |  |  |  |