Blood, Haemostasis and Immunity

Session Objectives.

What you will cover
- Blood composition
- Source of blood
- Function of blood cells
- Haemostasis [blood clotting]
- Nonspecific and specific defence systems.

Your objectives are
- Identify the main components of blood as formed elements and plasma
- State the function of blood
- State the basic functions of erythrocytes
- State the basic functions of leukocytes
- Outline the phases of haemostasis
- Explain the differences between the intrinsic and extrinsic pathways
- Describe the nonspecific defence systems of the body
- Describe the basic types of immunity
- State what an antigen is and explain immunogenicity and reactivity
- Describe the basic differences between T-cells and B-cells
- Give a basic description of humoral and cell mediated immunity.
- Describe the types of hypersensitivity reaction.

Suggested reading:
Tortora & Grabowski, 10TH Edition, Principles of Anatomy and Physiology, Ch 19, Ch 22
Marieb 6th Edition. Human Anatomy and Physiology, Ch 18, Ch 22
Gould 2ND Edition, Pathophysiology for Healthcare Professionals Ch 2, Ch 3, Ch 17
Blood, Haemostasis and Immunity

Blood provides the means for which the body’s cells receive vital nutrients and oxygen and dispose of their metabolic wastes. Blood has a role in homeostasis of body fluids, and in defence from invading pathogens or external damage.

**Task**

Complete the description of the components of blood by filling in the missing words.

In terms of tissue classification, blood is classified as a ______ because it has living blood cells called ______ suspended in a non-living fluid matrix called ______. The ‘fibres’ in this fluid matrix on become visible when blood has to ______.

If a blood sample is separated by centrifugation, the heavier blood cells become packed at the bottom of the tube. Most of this is composed of ______ and the volume of blood accounted for is referred to as the __________. The less dense plasma rises to the top and makes up about ______ of the blood volume. The so-called ‘buffy-coat’, made of ______ and ______ is found at the junctions of the other two blood elements. This represents less than ______ percent of the blood volume.

| Platelets | plasma | 1% |
| connective tissue | Formed elements | clot |
| packed cell volume | White blood cells | red blood cells | 45% |
Red Blood Cells
Simply put, the function of red blood cells is to transport oxygen. The image below shows a section of a blood cell and a magnification of the molecule.

Task
What is the name for the shape of a red blood cell?

What size is a red blood cell in micrometers.

How does the shape and size of these cells help their function?

What is the name of the larger molecule shown above, and what is it’s function?

White blood cells.
All white blood cells share a common function. They defend the body against foreign cells [pathogens], viruses, tumour cells and toxins.

Like red blood cells they mostly originate in the bone marrow. They can be classed according to the appearance of their cytoplasm. Some are classed as granulocytes, and others are classed as agranulocytes.

Task
Complete the table with the correct names.

<table>
<thead>
<tr>
<th>GRANULOCYTES</th>
<th>AGRANULOCYTES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Task
Give brief descriptions of the following properties of white blood cells.

Diapedesis

Phagocytosis

Chemotaxis

Blood Clotting – Haemostasis
To prevent blood loss after injury, blood vessels vasoconstrict and form physical barriers. These reactions prevent the loss of blood and establish a framework to repair the damaged tissue.

Task
Complete the table on the three phases of haemostasis. **BE BRIEF!**

<table>
<thead>
<tr>
<th>PHASE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular</td>
<td></td>
</tr>
<tr>
<td>Platelet</td>
<td></td>
</tr>
<tr>
<td>Coagulation</td>
<td>1</td>
</tr>
</tbody>
</table>

The diagram on the left shows the vascular and platelet phases of haemostasis.

Task.
Identify what is happening at the points labelled 1 and 2.

1.

2.

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Specific Defences – Immunity

Task
Complete the missing words. Use the words you have been provided.

<table>
<thead>
<tr>
<th>Antigens</th>
<th>B cells</th>
<th>Blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellular immunity</td>
<td>Lymph nodes</td>
<td>humoral immunity</td>
</tr>
<tr>
<td>Lymph</td>
<td>antibodies</td>
<td>T cells</td>
</tr>
<tr>
<td>lymph nodes</td>
<td>resistance</td>
<td></td>
</tr>
</tbody>
</table>

Immunity is __________________ to disease resulting from the presence of foreign substances or ___________ in the body. When this is provided by ______________ released to body fluids, the immunity is called ________________. When living cells provide the protection, the immunity is referred to as ________________. The major actors in the immune response are two lymphocyte populations, the ___________ and ___________. Phagocytic cells that act as accessory cells in the immune response are ______________. Because pathogens are likely to use both ___________ and ___________ as a means of getting around the body.
The flow chart shows the different types of immunity.

**Task**

What is the difference between active and passive immunity?

What is the difference between natural and acquired immunity?

Give examples of the following:

a) **natural active immunity**

b) **natural passive immunity**

c) **acquired passive immunity**
Recognition of self and non-self – Antigens.

Specific immune responses rely on three features. These are the ability to recognise invading pathogens or foreign tissue [non-self] from self, the production of protective cells and antibodies, and memory of previous encounters.

Think back to the structure of the plasma membrane with the phospholipid bilayer and the integral proteins.

Some of the proteins have additional ‘bits’ or chemical groups sticking on their external surfaces. These act as markers (or antigens) on the cell surface. They give the cells their identity and sense of ‘self’.

So, an antigen can be thought of as a protein that sticks out of the surface of the plasma membrane. This protein gives you your identity. It is a badge or like the way some football supporters wear their team colours or strip.

Antigens may also be known as antigenic determinants. A single cell will have many hundreds of these on the surface of the plasma membrane.

**Task**

Describe what is meant by a) antigen immunogenicity and b) antigen reactivity

a) Immunogenicity

b) Reactivity
The antibody response.
When someone encounters a foreign antigen, it is called a challenge. When pathogens or toxins challenge the immune system, there is an immune response. This can be measured in terms of the titre (measureable amount of antibody) of antibody produced.

Task
Explain what is meant by primary and secondary antibody responses.

Primary response

Secondary response

Task
Here is a diagram of the antibody response. Label the diagram with the appropriate texts by filling in the empty boxes with the words that have been provided.

<table>
<thead>
<tr>
<th>Days</th>
<th>Secondary response</th>
<th>Antibody titre</th>
</tr>
</thead>
<tbody>
<tr>
<td>First exposure</td>
<td>Second exposure</td>
<td>Primary response</td>
</tr>
</tbody>
</table>

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Task
What causes the secondary immune response?

What are the main features of the secondary immune response?

Which B-cells are responsible for the secondary immune response?

Cell Mediated Immunity
This involves the action of T-cells, and does not involve the production of antibodies.

Task
What are the two main types of T-cells involved in cell mediated immunity?

Briefly, what are the functions of these cells?

Abnormal Immune Responses
These can be classed as either autoimmune diseases, or hypersensitivity reactions.

Autoimmune diseases
These involve reactions where the body produces antibodies to self. Examples of autoimmune diseases are Multiple Sclerosis, Type I diabetes, and Rheumatoid Arthritis.
Hypersensitivity Reactions.
These are classed from Type I through to Type IV.

**Task**
Complete the table of definitions.

<table>
<thead>
<tr>
<th>Hypersensitivity Reaction</th>
<th>Common Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type IV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Suggested further reading/note preparation**
Blood function
Types of blood cells and their functions
Immune responses

**Web pages [accessed August 2004]**
http://www.unomaha.edu/~swick/blood.html  Blood cell histology
http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/B/Blood.html
http://www.people.virginia.edu/~rjh9u/abrsp1.html  The immune response
http://www.fleshandbones.com/readingroom/pdf/9.pdf  This is a pdf link to a book chapter.