Exercise 26
COMPOSITION OF BLOOD & WHITE CELL STUDY:

Introduction

Human blood is a type of **connective tissue** composed of a straw-colored liquid called **plasma** in which are suspended a variety of cells and cell fragments collectively referred to as **formed elements**. The plasma portion of the blood normally constitutes 50-55% of the total volume, the formed elements comprising the other 45-50%. Because most of the cells present are red blood cells (RBCs) or **erythrocytes**, the blood appears red in color. Normal human blood samples contain approximately 4.5-5 million RBCs per milliliter. Blood also contains a number of white blood cells (WBCs) or **leukocytes**, and cell fragments called platelets or **thrombocytes**.

Blood plasma contains mostly water and electrolytes, but also supports a variety of proteins including albumin, immunoglobulins and fibrinogen (a clotting factor). From a microbiological standpoint, the proteins of greatest interest are **complement factors**, and **antibodies** (immunoglobulins or **agglutinins**). **Serum** is blood plasma with the clotting factors removed, and often containing a high antibody titer. Erythrocytes (RBCs) are physiologically significant because they contain the hemoglobin involved in transporting blood gasses (oxygen and carbon dioxide). Erythrocytes are also important because they carry surface antigens (epitopes called **agglutinogens**) that can be used for blood typing. Thrombocytes are cell fragments derived from megakaryocytes, and function to prevent hemorrhage by plugging small breaks in blood vessel walls.

Human blood smears observed under oil immersion typically contain five types of leukocytes as well as erythrocytes and thrombocytes. When observed as living cells, these appear as refractile, colorless, objects, and are difficult to identify, therefore blood samples prepared for observation are typically stained with Wright's stain. Although RBCs are by far the most numerous cells in a blood smear, they do not contain nuclear material (are **enucleate**) so do not take on much color in the staining process. RBCs usually appear as pale pink/orange, lavender, or grayish. All of the leukocytes have nuclei, and some of them also contain granules that attract one or another of the dyes in the Wright's stain. For this reason, the leukocytes are more distinctive structures than RBCs, and can also be readily distinguished from one another. The different types of leukocytes and their percentages in a typical blood sample are as follows: **Neutrophils** or polymorphonuclear leukocytes (50-70%), **Lymphocytes** (20-30%), **Monocytes** or macrophages (2-6%), **Eosinophils** (1-5%), and **Basophils** (less than 1%). A mnemonic device helpful for remembering the relative abundance of WBCs (from most to least) is: Never (neutrophils), Let (lymphocytes), Monkeys (monocytes), Eat (eosinophils), Bananas (basophils).

The numbers (percentages) of the various types of leukocytes in a blood sample is of great significance in the diagnosis of infectious disease. High neutrophil counts, or **neutrophilia**, are often indicative of some localized, acute infection such as an abscess or appendicitis. **Neutropenia**, a condition marked by a decrease in neutrophil number, occurs in association with a variety of disease states including typhoid fever and influenza. **Eosinophilia** (high eosinophil count) is indicative of an allergic reaction as might occur in response to chemicals or to parasitic invasion (eosinophil counts may rise as much as 50% in response to trichinosis). High lymphocyte counts (**lymphocytosis**) are often associated with whooping cough and certain viral infections. The normal white blood cell count is around 6-10,000 cells per cubic millimeter (milliliter) of blood, but during **leukocytosis** (elevation in leukocyte count) due to infection, the number may reach 30-40,000.

In this exercise we will examine prepared blood smears, and determine the relative percentages of the various types of white blood cells present (a total of 100 white blood cells will be recorded as to type). This is referred to as a differential count, and will be helpful as a means of familiarizing students with the different types of white blood cells visible in stained blood smears.

Students may be asked to recognize and identify (name) any or all of the five different types of white blood cells (leukocytes) during laboratory exam #2, so gaining a working familiarity with these cell types is highly recommended.

Procedure:

1. Obtain a prepared slide of human blood and scan it with the low power (10x) objective to find an area with uniform cell distribution and minimal distortion.

2. Locate one or more dark-stained, nucleated cells and center these within the field of view; then swing the high dry (45x) lens into position.

3. While looking at the slide, gradually move the stage and identify the different types of white blood cells (leukocytes) as they come into your field of view. Try to find representative examples of all five different types of leukocytes.

4. When you feel confident you can identify the different types of white blood cells, count all the leukocytes visible within the viewing field while moving it from one side of the preparation to the other. Record the number of each cell type observed. **Note -** Cells at the outermost edge of the preparation may be badly distorted and difficult to identify. If this is the case, count only those cells appearing normal or typical.

Questions:

1. What are erythrocytes, leukocytes and thrombocytes? How many different types of leukocytes are normally found in a blood sample.

2. What is neutrophilia, and what is it indicative of?

3. What condition might result in eosinophilia?

4. Which type of leukocyte are you least likely to observe in a typical blood smear?