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# LearnSmart Labs: Blood

## General Lab Outline

**Total Time: 2 hr, 15 min**

- I. Core Concepts: Blood (15 min)**
- II. Blood Smear and Differential White Cell Count (40 min)**
- III. Hematocrit (20 min)**
- IV. Hemoglobin Content (20 min)**
- V. Blood Typing Test (20 min)**
- VI. Final Summary Questions (10 min)**
- VII. Reports**

## Assessed Learning Outcomes

- 1. Core Concepts: Blood
  - a. Recall that blood is composed of plasma and the formed elements
  - b. Structure and function of the formed elements
    - i. Recall the structure and function of red blood cells
    - ii. Recall the structure and function of white blood cells
    - iii. Recall the structure and function of platelets
    - iv. Compare the structure and function of the formed elements
  - c. Understand the basis of blood typing
    - i. Recall the red blood cells are covered in antigens, and plasma contain antibodies for foreign antigens
    - ii. Match blood types and antibodies
    - iii. Explain when transfusion reactions occur
  - d. Recall how to safely handle human blood
- 2. Blood Smear and Differential White Cell Count
  - a. Pre-lab Briefing
    - i. Recall the steps to perform a blood smear
    - ii. Recall how to perform a differential white blood cell count
  - b. Identify different white blood cells
    - i. Identify platelets in a blood smear slide
    - ii. Identify erythrocytes in a blood smear slide
    - iii. Identify neutrophils in a blood smear slide
    - iv. Identify lymphocytes in a blood smear slide
    - v. Identify monocytes in a blood smear slide
    - vi. Identify eosinophils in a blood smear slide
    - vii. Identify basophils in a blood smear slide

- c. Stimulation of Blood Smear and Differential White Cell Count
    - i. Prepare a blood smear
      - 1. Add a drop of blood
      - 2. Smear the blood drop
      - 3. Let blood smear dry in the air
    - ii. Stain the blood smear
      - 1. Add Wright's stain to blood smear
      - 2. Let Wright's stain react for a suitable time
      - 3. Add distilled water to the slide with stain
      - 4. Let the stain and water mixture react for a suitable time
      - 5. Rinse the stained blood smear
      - 6. Let the slide air dry
    - iii. Perform the correct procedure without guidance
    - iv. Dispose of materials contaminated with blood in biohazard container
    - v. Perform a different count on prepared microscope slide
    - vi. Differential cell count
      - 1. Count the correct number of neutrophils
      - 2. Count the correct number of lymphocytes
      - 3. Count the correct number of monocytes
      - 4. Count the correct number of eosinophils
      - 5. Count the correct number of basophils
    - vii. Infer the patient's health problem from the results of the differential white cell count
  - d. Post-lab probing
    - i. Explain the outcome if the stain acts for the wrong time
    - ii. Identify the normal values of a differential's white blood cell count
    - iii. Know the relationship between an abnormal differential white cell count and likely diseases
3. Hematocrit
- a. Pre-lab Briefing
    - i. Recall how to prepare a blood sample for a hematocrit test
  - b. Stimulation of Hematocrit Test
    - i. Fill a capillary tube with blood
    - ii. Seal capillary tubes
    - iii. Separate blood and plasma in the centrifuge
    - iv. Measure the hematocrit for one blood sample
    - v. Test all 5 blood samples
    - vi. Balance centrifuge
    - vii. Recall how to place the capillary tubes in centrifuge
    - viii. Infer whether test results indicate doping
    - ix. Use safe blood handling practices
    - x. Avoid cross-contamination samples

- c. Post-lab Probing
    - i. Explain the purpose of a hematocrit test
    - ii. Recall the normal hematocrit levels
- 4. Hemoglobin Content
  - a. Pre-lab Briefing
    - i. Recall how to prepare a blood sample for a hemoglobin test
  - b. Simulation of Hemoglobin Test
    - i. Test the three blood samples and positive and negative controls
    - ii. Stir until all hemoglobin is out of the red blood cells
    - iii. Measure the hemoglobin content
    - iv. Use safe blood handling practices
    - v. Avoid cross-contaminating samples
    - vi. Recall why hemolysis applicators are used
    - vii. Infer whether test results indicate doping
  - c. Post-lab Probing
    - i. Explain the purpose of hemoglobin test
    - ii. Recall the normal hemoglobin content
- 5. Blood Typing Test
  - a. Pre-lab Briefing
    - i. Recall how to determine the blood type
    - ii. Recall which transfusions lead to transfusion reactions
  - b. Simulation of Blood Typing Test
    - i. Test all blood samples
    - ii. Label the test slides
    - iii. Recall how the slides should be labeled
    - iv. Add blood from only one patient to each slide
    - v. Add the test serum to the labeled spot on the slide
    - vi. Determine the blood type
    - vii. Use safe blood handling practices
    - viii. Avoid cross-contaminating blood samples
    - ix. Recall why toothpicks are used in this experiment
    - x. Use your results to determine who can donate blood to whom
  - c. Post-lab Probing
    - i. Realize the need for type O packed cell transfusion when donor and recipient do not exactly match
- 6. Final Summary Questions
  - a. Differentiate between the purpose of the various blood tests

**INSTRUCTOR NOTE:** Safety requirements for blood handling may vary slightly from those used in this lab. Students may become frustrated if they begin to miss questions. Remind them that when missing a question they should remediate using the provided learning resource, most often a Slide, or the Library for that topic.

## Student Instructions for Lab Experiments

### **Overview for All Experiments:**

In the following exercises you will perform tests that allow you to examine the nature of blood and also let you evaluate different samples of blood.

These tests are useful diagnostic tools for physicians because blood composition reflects the status of many body functions and malfunctions.

Before getting started on the actual lab, I would like to go over some core concepts related to blood testing. Then you will proceed with the experiments.

### **Differential WBC Count:**

In this experiment, you will prepare a microscope slide with a blood smear and perform a differential white blood cell count.

Before you start, I want to make sure that you have the necessary knowledge to execute the experiments.

Let's make sure you know how to prepare a blood smear microscope slide and how to perform a differential white blood cell count.

Important to Know About Blood Samples:

- What is a blood smear and how to make one
- How to stain a blood sample
- How to identify the different white blood cells
- What is a differential white blood cell count

Drag the labels from the right hand side to the correct locations on the slide. Select "Submit" when you are done.

Identify the different cells

Give Feedback

Labels

- ☐ Monocyte
- ☐ Lymphocyte
- ☐ Erythrocytes
- ☐ Eosinophil
- ☐ Basophil
- ☐ Neutrophil
- ☐ Platelets

Submit

**INSTRUCTOR NOTE:** Often the Coach will appear at the top right. Sometimes students think she is in the way of completing the exercise. However, if they are patient, she will disappear when she completes talking. Students can reactivate her and make her repeat instructions by clicking on her refresh icon.

Drag the labels from the right hand side to the correct locations on the slide. Select “Submit” when you are done.

GIVE FEEDBACK

- ☐ Microscope slides
- ☐ Wright's stain
- ☐ Staining rack
- ☐ Distilled water
- ☐ Pipettes
- ☐ Blood sample
- ☐ Microscope
- ☐ Blood smear
- ☐ Hazardous waste
- ☐ Filtered water

SUBMIT >

### Simulator:

Click the Instructions button and follow the steps to make a blood smear.

Move the slide to the microscope to view it.

First, correctly focus the microscope slide. Move to the x40 objective to complete the count.

### Hematocrit:

In this experiment, you will measure the hematocrit of blood samples.

Before we begin, I want to make sure you have the knowledge you need to execute the experiment and interpret your results.

Let's learn more about the hematocrit of a blood sample

Important to Know About Hematocrit Testing:

- What is the hematocrit value
- How is a hematocrit test performed

Drag the labels from the right hand side to the correct locations on the slide. Select “Submit” when you are done.

Identify the equipment in the lab

Give Feedback

Labels

- Centrifuge
- Alcohol swabs
- Capillary tubes
- Hematocrit chart
- Sharps container
- Blood samples
- Clay sealant

Submit

### Simulator:

Click the Instructions button and follow the steps to determine the hematocrit.

Compare the hematocrit to blood doping samples.

**INSTRUCTOR NOTE:** Students will see a number of possible combinations of doping results and hematocrit levels. If they repeat the experiment, they should expect different results. Each student should have different results.

### Hemoglobin Content:

In this experiment, you will measure the hemoglobin content of blood samples.

Before we begin, I want to make sure you have the knowledge you need to execute the experiment and interpret your results.

Let's learn more about the hemoglobin content of blood and how to determine it.

Important to Know About Hemoglobin

- Hemoglobin in red blood cells
- How to measure the hemoglobin content of blood

Student labeling activity before entering lab simulation

Identify the equipment in the lab

Give Feedback

Labels

- ☐ Alcohol wipes
- ☐ Hazardous waste
- ☐ Blood samples
- ☐ Hemolysis applicators
- ☐ Blood chamber
- ☐ Hemoglobinometer
- ☐ Pipettes

Submit



### Simulator:

Click the Instructions button and follow the steps to determine the hemoglobin content.

Compare the hemoglobin content to blood doping samples.

**INSTRUCTOR NOTE:** The two halves in the hemoglobinometer will not have a line between them when the correct reading is available. Students will see a number of possible combinations of doping results and hemoglobin concentrations. If they repeat the experiment, they should expect different results. Each student should have different results.

### Blood Typing:

In this experiment, you will determine the blood type of some blood samples.

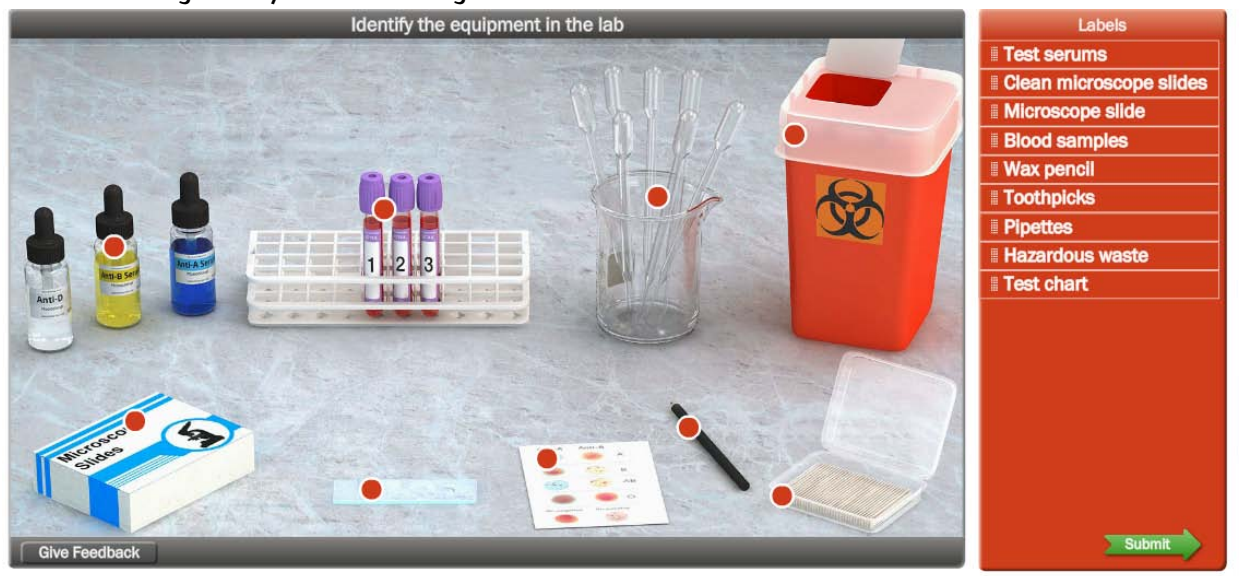
Before we begin, I want to make sure you have the knowledge you need to execute the experiment and interpret your results.

Let's learn more about the blood typing test.

Important to Know About Blood Typing

- How to determine the blood type
- Transfusion reactions

Student labeling activity before entering lab simulation



### **Simulator:**

Click the Instructions button and follow the steps to determine the blood types.

Remember to label your slides with the sample and test types.

INSTRUCTOR NOTE: Students will see a number of possible combinations of blood types. If they repeat the experiment, they should expect different results. Each student should have different results.

### **Final Summary Questions**

- a. Differentiate between the purpose of the various blood tests

INSTRUCTOR NOTE: These final summary questions are designed to assess students that have completed all components of the lab. If you only assign some of the exercises and have not instructed students on the other techniques in class, your students may struggle with some of these questions.

### **Type of Student Report**

Students are provided the following types of reports at the conclusion of these lab experiments.

- I. Blood Smear and Differential White Cell Count – *Debriefing*
- II. Hematocrit – *Debriefing*
- III. Hemoglobin Content – *Debriefing*
- IV. Blood Typing Test – *Debriefing*

## LearnSmart Labs: Diffusion

### General Lab Outline

**Total Time: 2 hrs**

- I. Core Concepts: Diffusion (10 min)**
- II. Diffusion in Different Media (1 hr, 20 min)**
  - a. Concepts: Diffusion in Different Media (10 min)**
  - b. Diffusion in a Semi-Solid (30 min)**
  - c. Diffusion in a Liquid (20 min)**
  - d. Diffusion in Air (20 min)**
- III. Diffusion Across a Membrane (20 min)**
  - a. Concepts: Diffusion Across a Membrane (10 min)**
  - b. Diffusion Across a Selectively Permeable Membrane (10 min)**
- IV. Final Summary Questions (10 min)**
- V. Reports**

### Assessed Learning Outcomes

- 1. Core Concepts: Diffusion**
  - a. Understand the terms solution, solute & solvent
  - b. Understand what a concentration gradient means
  - c. Understand molecular motion
  - d. Understand diffusion is a result of random movement
  - e. Explain what happens during diffusion
- 2. Diffusion in Different Media**
  - a. Core Concepts: Diffusion in Media**
    - i. Compare diffusion through a semisolid, a liquid and a gas
    - ii. Understand how diffusion speed depends on molecular speed
  - b. Diffusion in a Semi-Solid**
    - i. Experiment**
      - 1. Formulate a hypothesis
      - 2. Design an experiment where you test the effect of concentration on diffusion speed
      - 3. Experiment phase
        - a. Put a different number of crystals on each plate
        - b. Place all crystals in a relatively short time to make sure all crystals are contributing equally
        - c. After starting measurements, do not change the number of crystals
        - d. Take a sufficient number of measurements
        - e. Measure diameters correctly