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# Draw It Wright: Creating Art to Learn Blood Cell Types in Laboratory or Lecture

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The traditional biology lecture is an efficient way to deliver large volumes of content. Unfortunately, high-volume content delivery does not consistently translate into improvement in student learning. Students often struggle to understand blood cells and their related functions, relying on rote memorization. This protocol provides an alternative pedagogical approach that can be easily integrated into a variety of biology courses in the lab or lecture and adapted for science outreach. Students will engage in a series of observe/draw/discuss exercises using human blood smear slides stained with Wright Stain, an accessible and clinically relevant assay, which visually defines blood cell types.

**Keywords:** Wright Stain, Art in Lab, Blood

## Introduction

When learning about connective tissues in Anatomy/Physiology or Intro Biology, many students struggle to link structure and function of peripheral blood cell types. This exercise employs observation-based drawing to help students learn the relative numbers, morphology and types of blood cells. Drawing engages both motor and visual learners, and is a simple way to foster science literacy and engage science curricula (Ainsworth et al, 2011). We find that using drawing either as a tool for close observation, as in this exercise, or to represent challenging concepts, such as the resting membrane or action potential, improves student learning and retention of information in both short and long term assessments. It can also be a source of immediate feedback for instructors in order to detect student misunderstanding (Krajcik and Sutherland, 2010). The Wright stain, developed in the early 1900s, differentiates peripheral blood cell types (Hackling and Prain, 2005). It is a straightforward assay that can be easily accomplished in a single lab period. This exercise can be used as an addendum to either lecture or lab. We have also adapted it as a science outreach activity. Students do not need an art background to participate effectively. Basic understanding of connective tissue and blood cells is helpful to provide a context for the exercise, but not necessary. This exercise can also be adapted for learning about a diversity of cell types.

# Student Outline

**Pre-laboratory Preparation**

In this laboratory exercise you will learn about the diversity of cell types in human blood. Before you begin, it is suggested that you investigate these websites to familiarize yourself with connective tissue and the clinical context in which the Wright stain would be used:

http://www.hematology.org/Patients/Basics/
http://web.mit.edu/scicom/www/blood.html
http://www.ncbi.nlm.nih.gov/books/NBK2263/
http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/B/Blood.html
http://www.unomaha.edu/hpa/blood.html

Once you have thoroughly reviewed the recommended websites, define the role(s) of the following cell types:

Erythrocytes
Neutrophil
Lymphocyte
Basophil
Eosinophil
Macrophage
Platelet

**Laboratory Exercises**

Your instructor will provide you with a pre-made blood smear on a microscope slide. Follow the protocol for Wright Stain. Once you have completed staining the slide, place it on a light microscope stage. Focus and scan the slide under both low (10x) and high (40x) power magnification observing visual differences in cell types (approximately 10-15 minutes).

*Exercise #1: Complimentary of form and function in Erythrocytes and Leukocytes*

Focus on a view under 40x magnification. You will be given 5 minutes to draw the view, rescan the slide and focus on another view, and draw a second drawing for 5 minutes. Use colored pencils or similar media that come in a range of colors for your drawings. Carefully observe and draw, focusing on such features such as size of cells, shape of cells, colors of the cells as well as distribution of pigment, visible internal organelles, etc. Once you have completed your drawings, discuss your drawings in small groups and describe what you observed.

*Exercise #2: Diversity of Leukocytes*

Scan and focus on a leukocyte under 40x or 100x magnification (oil immersion can be used for 100x). You will be given 5 minutes to draw the leukocyte, rescan the slide and focus on another leukocyte, and draw a second drawing for 5 minutes. Use colored pencils or similar media that come in a range of colors for your drawings. Once you have completed your drawings, discuss your drawings in small groups and describe what you observed.

*Exercise #3: Diversity of Erythrocytes*

Scan and focus on an erythrocyte under 40x or 100x magnification (oil immersion can be used for 100x). You will be given 5 minutes to draw the erythrocyte, rescan the slide and focus on another erythrocyte, and draw a second view for 5 minutes. Use colored pencils or similar media that come in a range of colors for your drawings. Once you have completed your drawings, discuss your drawings in small groups and describe what you observed.

## Notes for the Instructor

**Materials and Equipment**

Materials and equipment necessary for the exercises below include light microscopes with low and high power objectives, water, beakers for liquid waste, colored pencils (or other media that provide a range of colors e.g. crayons, oil pastels, markers, inks etc.), paper.

**Protocol for Laboratory Exercise and Drawing**

Each student will receive a human blood smear on a microscope slide. Slides will then be stained according to the Carolina Wright Stain procedure (Carolina Kit – Human Blood Smear Cat#700-388). The fixation and staining procedure takes approximately 40 minutes to complete. If time does not allow for the staining procedure, Instructors can also purchase pre-stained microscope slides. Students will then be allotted time to scan and focus the microscope under both low (10x) and high (40x) power magnification (approximately 10-15 minutes).

*Exercise #1: Complimentary of form and function in Erythrocytes and Leukocytes*

Instruct students to focus on a view under 40x magnification. Students are then given 5 minutes to draw the view, rescan the slide and focus on another view, and draw a second drawing for 5 minutes. Students should use colored pencils or similar media that come in a range of colors. Students should carefully observe and draw, focusing on such features such as size of cells, shape of cells, colors of the cells as well as distribution of pigment, visible internal organelles, etc. Once students have completed their drawings, ask students to discuss their drawings in small groups and describe what they observed. Instructors will then lead a group discussion; in this exercise the group discussion will focus on the following points:

1. How does the number of erythrocytes compare to the number of leukocytes? How does this relate to the normal function of both cell types?
2. How does the size of the erythrocytes compare to the size of the leukocytes? How do these cell types travel throughout the body and how might their size impact their routes of travel?
3. What is the shape of the erythrocyte compared to the shape of the leukocyte? How does their shape relate to their function?
4. Were nuclei observed? If so, in what cell type(s)? What implications does this have for cell maturity and function?

*Exercise #2: Diversity of Leukocytes*

Instruct students to scan and focus on a leukocyte under 40x or 100x magnification (oil immersion can be used for 100x). Students are then given 5 minutes to draw the leukocyte, rescan the slide and focus on another leukocyte, and draw a second drawing for 5 minutes. Students should use colored pencils or similar media that come in a range of color. Once students have completed their drawings, ask students to discuss their drawings in small groups and describe what they observed. Instructors will then lead a group discussion; in this exercise the group discussion will focus on the following points:

1. What features of leukocytes vary between different sub-types? What features of leukocytes remain consistent? How is this related to the function of leukocytes?
2. What different leukocytes were observed within the class? How does this relate to the numbers of leukocyte types expected in a normal (non-pathological) human blood smear?
3. What similarities and differences might you expect to see in a human blood smear taken from someone with an infection at 24 hours? At 72 hours? What similarities and differences might you expect to see in a human blood smear taken from someone with an allergic reaction?

*Exercise #3: Diversity of Erythrocytes*

Instruct students to scan and focus on an erythrocyte under 40x or 100x magnification (oil immersion can be used for 100x). Students are then given 5 minutes to draw the erythrocyte, rescan the slide and focus on another erythrocyte, and draw a second view for 5 minutes. Students should use colored pencils or similar media that come in a range of color. Once students have completed their drawings, ask students to discuss their drawings in small groups and describe what they observed. Instructors will then lead a group discussion; in this exercise the group discussion will focus on the following points:

1. What is the shape of an erythrocyte and how does it relate to its function?
2. Do mature erythrocytes contain nuclei? How might this impact their function and cell longevity?
3. What similarities and differences might you expect to see in a human blood smear taken from someone with microcytic and macrocytic anemias? What similarities and differences might you expect to see in a

human blood smear taken from someone with sickle cell anemia?

**Protocol for In-Lecture Drawing**

Instructors who do not have time in the laboratory to complete the Wright Stain procedure and/or do not have access to microscopes can still complete the various exercises. Instructors can use images projected on a monitor to mimic microscope views. Suggested links for high quality images include:
http://bigpictureeducation.com/blood-cells-images
http://www.wadsworth.org/chemheme/heme/microscope/celllist.htm
http://www.siumed.edu/~dking2/intro/bldsmear.htm

**Adapting Draw It Wright for Science Outreach**

We developed Draw it Wright as part of a series of Art in the Lab Workshops. These events give scientists and artists, students and professionals the opportunity to collaborate to create art in a variety of media (pencil, charcoal, ink etc) based on authentic laboratory experiences including microscope work and interaction with gross scientific models. The workshops begin with a brief introduction to a scientific concept/theme which is the focus of the laboratory work as well as an introduction to an artistic technique, thus providing education to both the artists and the scientists and initiating an organic dialogue between participants from the different disciplines. The remainder of the workshop is run as a drawing class, beginning with a round robin of short (2-5 minute) warm-up drawings and then a series of longer (15 minute) drawings which allow the participants to engage more deeply with the subject matter. The workshop concludes with the opportunity for development of a larger piece (45 minutes). All workshop participants are given the option of displaying their work in a professionally-curated exhibit in Brooklyn Heights.

**Sample Drawing Outcomes**

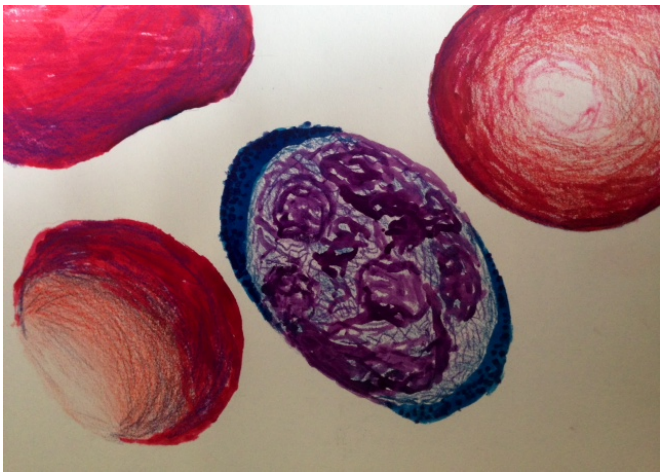

**Figure 1.** Sample outcome, focused drawing of a basophil surrounded by erythrocytes.

**Figure 2.** Sample outcome, focused neutrophil drawing.

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## About the Authors

Alison Dell received her Ph.D. from the University of Pennsylvania in 2013. Her doctoral work examined local cell signaling events in developing neurons as their axons navigate towards their synaptic partners. She continues this research as Assistant Professor at St. Francis College and through research appointments at the University of Pennsylvania (Associate) and at the Albert Einstein School of Medicine (visiting Assistant Professor). Her research interests include cell signaling in neural and cardiac development as well as the impact of common environmental toxins on these processes. Alison is also a visual artist – interested in the forms, patterns and structures she studies in lab.

Irina Ellison (B.A., Biology, Vassar College, 2000; Ph.D., Pathology, New York Medical College, 2005) is an Associate Professor and Program Head of Health Science at Mercy College. Dr. Ellison, a translational biologist with over 10 years of teaching and academic administrative experience at the graduate and undergraduate levels, is passionate about improving science literacy and guiding her students toward realizing their professional goals in the health sciences. Dr. Ellison has been recognized for excellence in teaching; her effectiveness as a teacher is grounded in her command of the field and her ability to understand the needs of her diverse students and to assist them in making meaningful connections with the material. Her research interests are focused on public health and health promotion.

## Mission, Review Process & Disclaimer

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