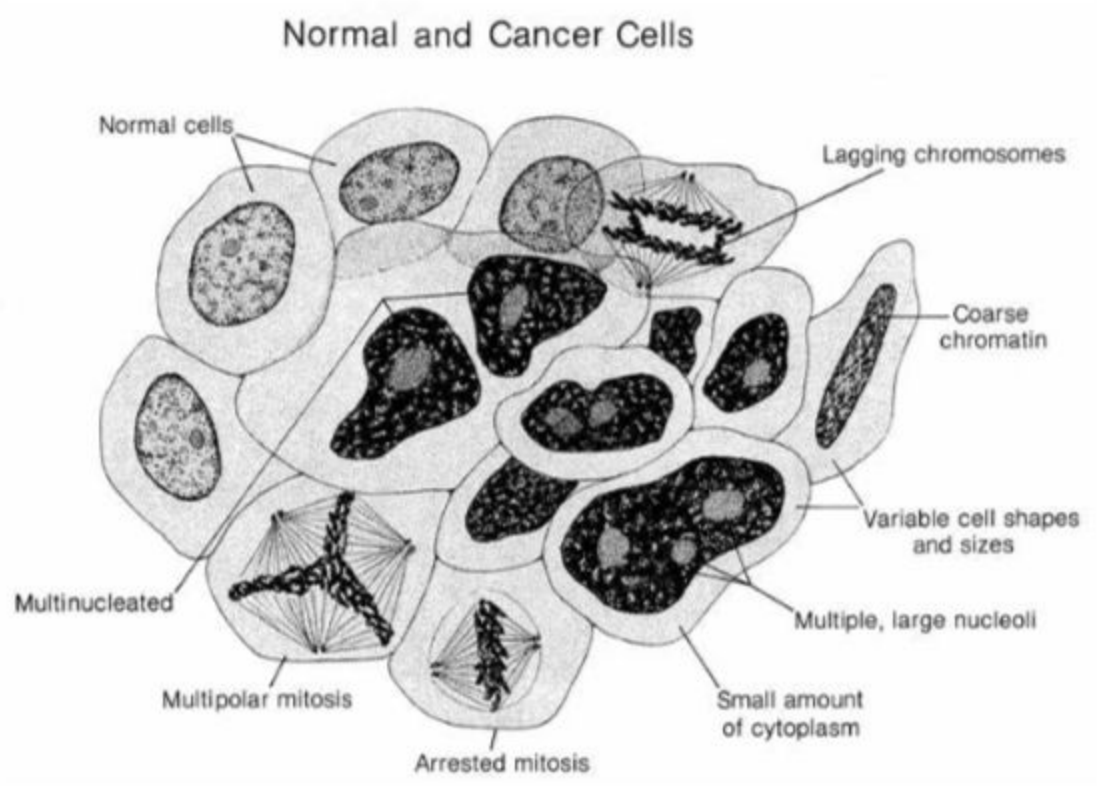
Lab 4: Normal and Abnormal Cell Division: Which of These Patients Could Have Cancer?

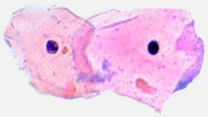
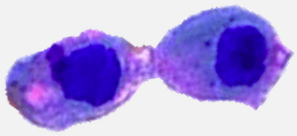
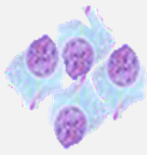
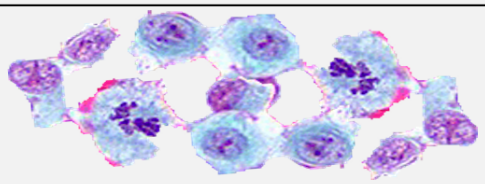
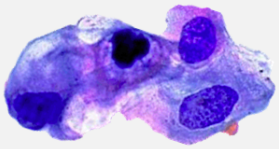
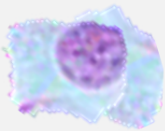
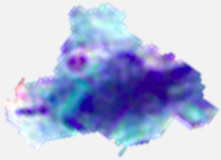
Introduction

Hundreds of genes control the process of cell division in normal cells. Normal cell growth requires a balance between the activity of those genes that promote cell division and those that suppress it. It also relies on the activities of genes that signal when damaged cells should undergo apoptosis (programmed cell death). Cells become cancerous after mutations accumulate in the various genes that control cell division. Some mutations occur in genes that stimulate cell division, which triggers these cells to start dividing. Other cancer- related mutations inactivate the genes that suppress cell division or those that signal the need for apoptosis. Gene mutations accumulate over time as a result of independent events.

The figure below provides an illustration of normal and cancerous cells. A normal cell often has a great deal of cytoplasm and one nucleus, and it is about the same size and shape as the cells that it borders. A cancerous cell, in contrast, often has a small amount of cytoplasm, more than one nucleus, and an abnormal shape. Cancerous cells also divide faster than normal cells do, so there is a greater chance that these cells will be in one of the stages of mitosis. The stages of mitosis in a cancerous cell, however, will often look different than they do in a normal cell. For example, the chromosomes may be pulled toward three or more centrioles (instead of two), and some chromosomes may lag behind others during anaphase. These types of abnormalities are often present because the genes in the cells that trigger apoptosis are no longer functional.

Normal and cancer cells side by side, with normal and cancerous characteristics identified



Normal	Cancer	
		Large, variably shaped nuclei
		Many dividing cells; Disorganized arrangement
		Variation in size and shape
		Loss of normal features

As a mass of cancerous cells grows, it develops into a tumor. Tumors often remain confined within the normal boundaries of a tissue during the early stages of cancer. As time passes, however, tumors will often break through the boundaries of a tissue and invade adjoining tissues. These tumors are described as malignant. Sometimes individual cancer cells will break off from a malignant tumor and travel to other parts of the body, leading to the formation of new tumors at those sites. This process is called metastasis, and it occurs during the terminal stages of cancer. Tumors that are not capable of invading adjoining tissue are described as benign.

A medical doctor will often order a procedure called a biopsy if he or she suspects that a patient has a tumor. As part of a biopsy, the doctor or other medical professional will remove a piece of tissue or a sample of cells from a patient's body so that it can be examined in a laboratory by a pathologist. The pathologist will prepare several histological slides of the tissue and use a microscope to look for the presence of cancerous cells. The pathologist will then prepare a pathology report for the medical doctor. The pathology report describes the results of the analysis and the opinion of the pathologist.

Your Task

You will be provided with prepared slides of healthy tissue and images of slides from four different individuals. Examine the slides and these images and use what you know about the appearance of cells and what proportion of time cells tend to spend in each stage of mitosis to determine if any of the individuals have cancer. The guiding question of this investigation is: ***Which of these patients could have cancer?***

Materials

You may use any of the following materials during your investigation:

- A prepared slide containing human blood
- Microscope
- Images of histological slides from patients 1, 2, 3, 4, and 5

Getting Started

To answer the guiding question, you will need to design and conduct an investigation to examine the characteristics of typical cells found in human blood. You will then compare these cells with the images of cells taken from four patients. To accomplish this task, you must determine what type of data you will need to collect, how you will collect it, and how you will analyze it.

To determine *what type of data you need to collect*, think about the following questions:

- What type of measurements or observations will you need to record during your investigation? (Hint: What are the characteristics of cancerous cells?).
- Will you collect one type of data (appearance of cells only) or multiple types of data (appearance of cells and proportion of time spent in various stages of the cell cycle)?

To determine *how you will collect your data*, think about the following questions:

- What will serve as a control (or comparison) condition?
- How will you collect data? (Hint: Higher magnifications make counting cells and comparing easier.)
- How will you make sure that your data are of high quality (i.e., how will you reduce error)?
- How will you keep track of the data you collect and how will you organize the data?

To determine *how you will analyze your data*, think about the following questions:

- What type of calculations will you need to make?
- What type of graph could you create to help make sense of your data?

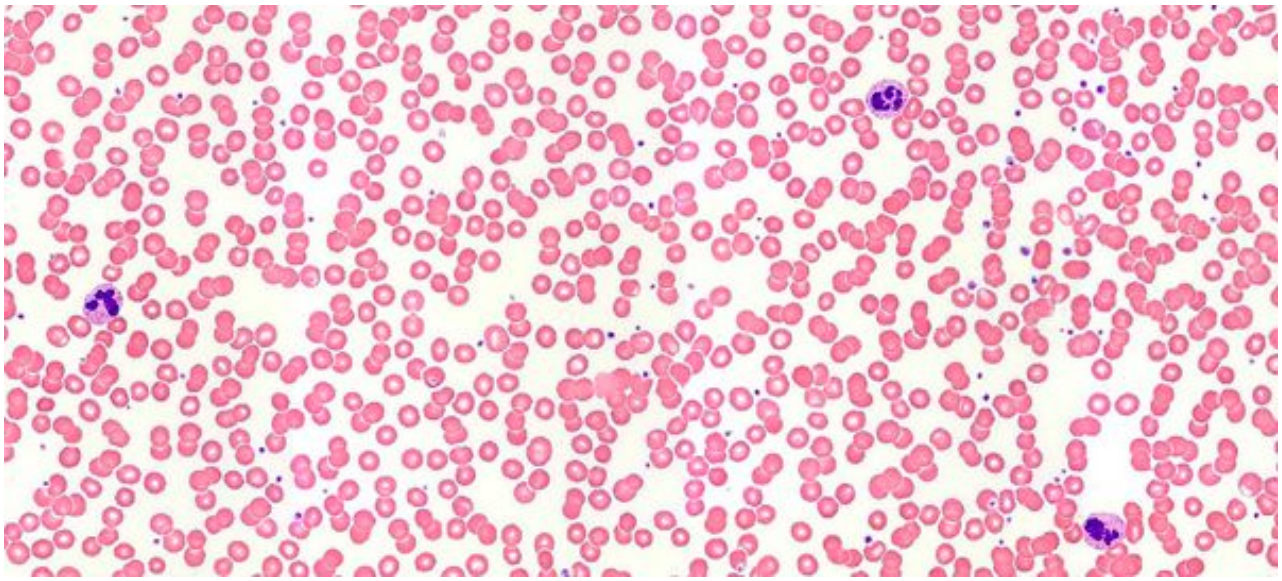
Report

Once you have completed your research, you will need to prepare an investigation report that consists of four sections (be sure to have section headings):

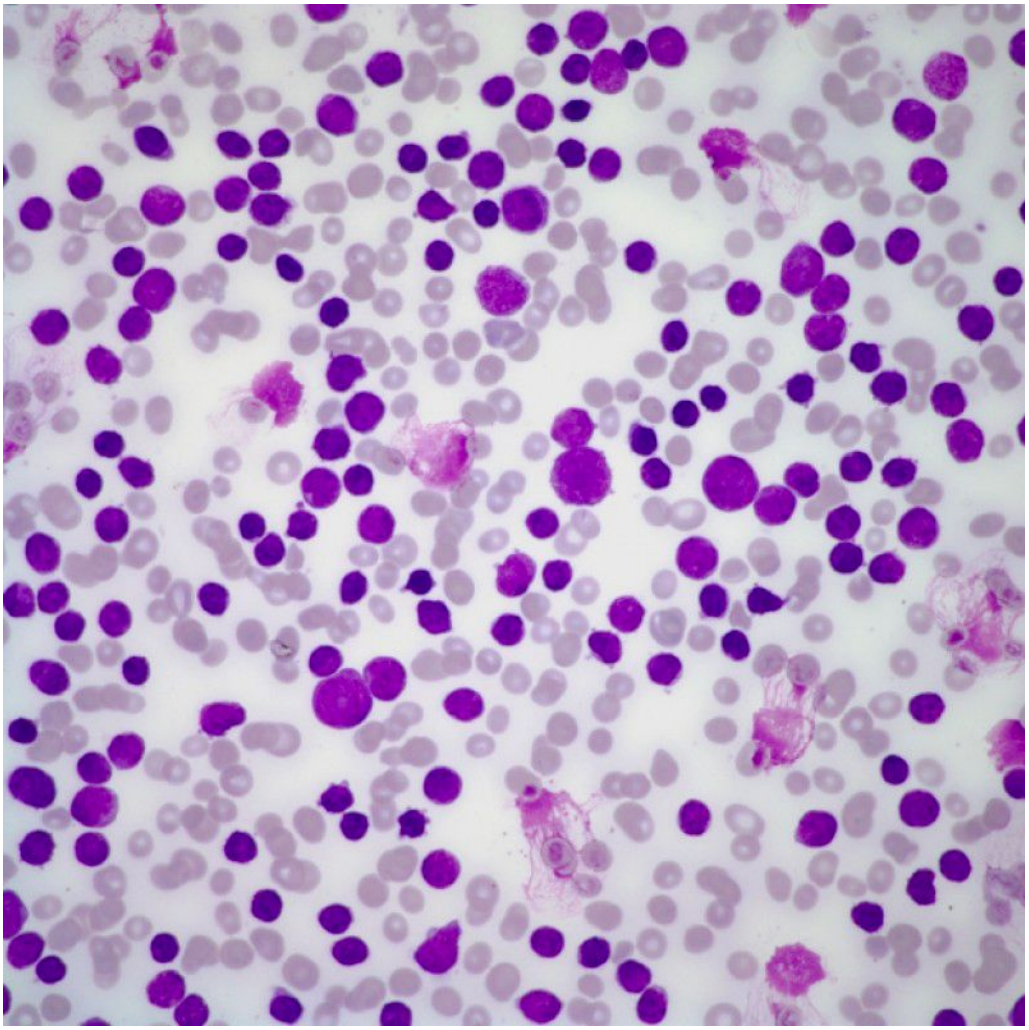
1. Introduction: Give some background information on the topic. Explain what question were you trying to answer and include a hypothesis. (Background info, research question and hypothesis)
2. Procedure: What did you do during your investigation and why did you conduct your investigation in this way? (How you collected and analyzed data)
3. Data: Include a data table and/or graph to show your results. Be sure to include a title for your table or graph with labels for the variables.
4. Conclusion: What is your argument? (Claim - Evidence - Reasoning)

Your report should answer these questions in two pages or less. The report must be typed, and any diagrams, figures, or tables should be embedded into the document. Type your report on Google Docs (12 point font, double-spaced) and share it with your teacher. Your report will be graded based on the rubric in the class syllabus.

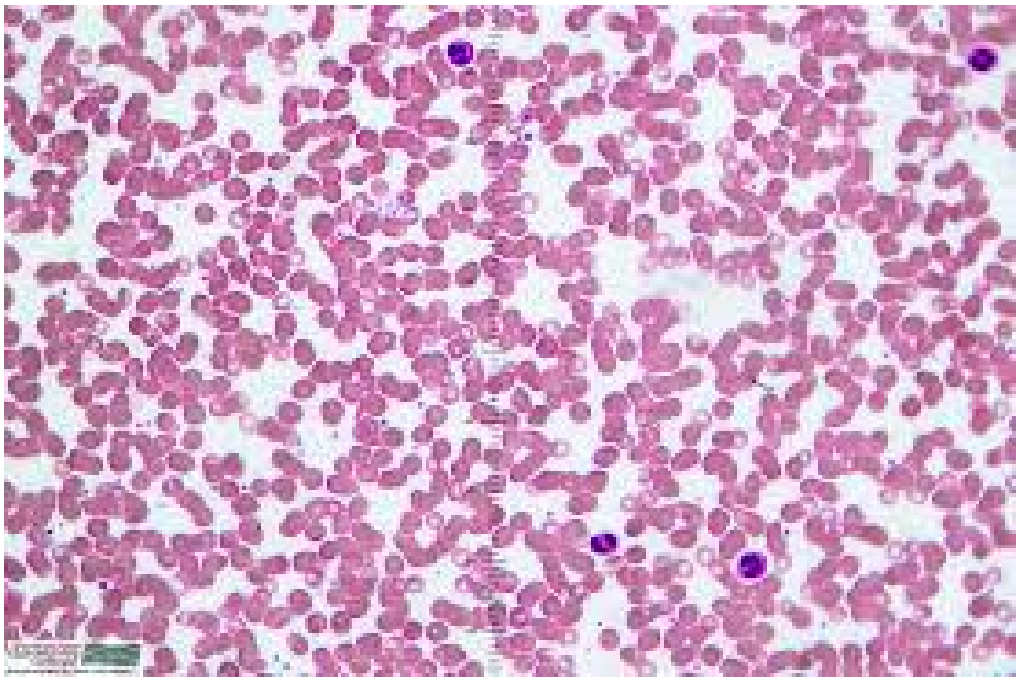
Healthy Human Blood Slide



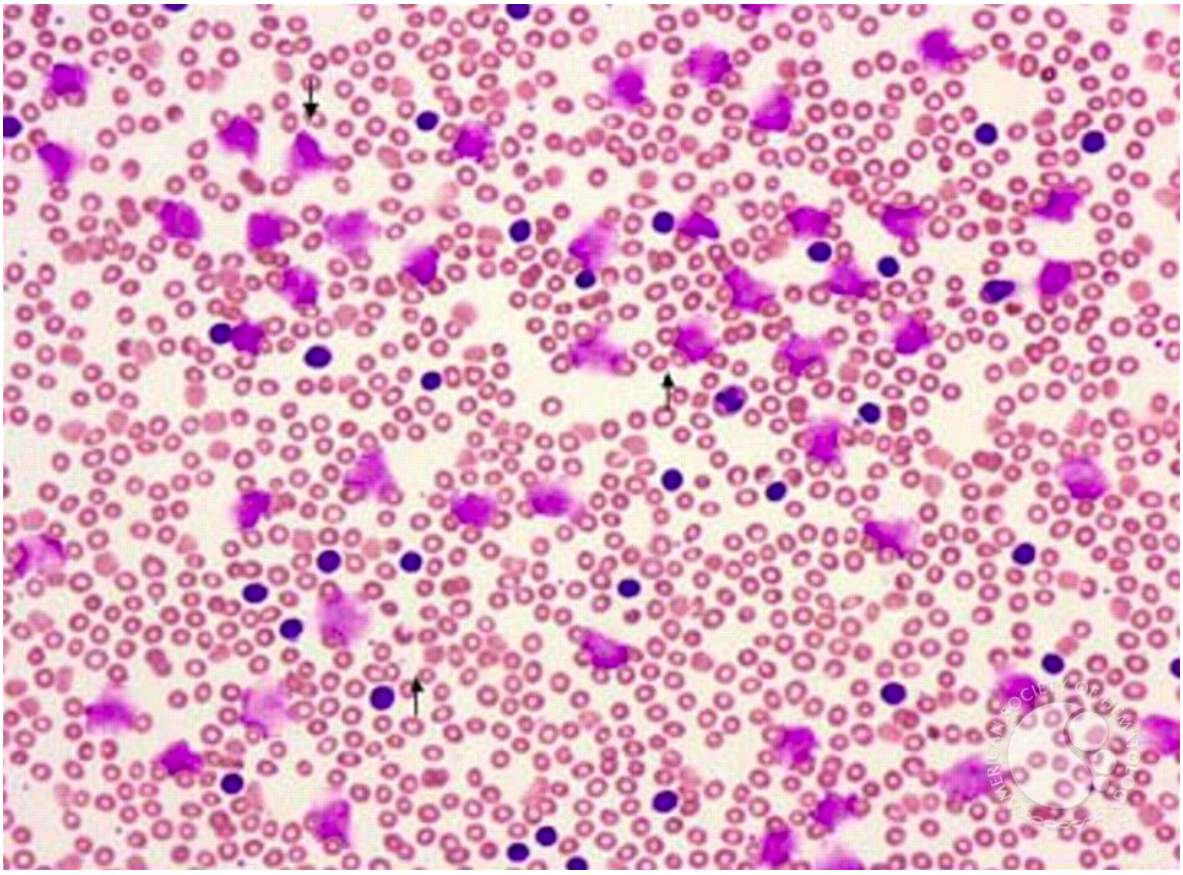
Blood Sample from Patient 1



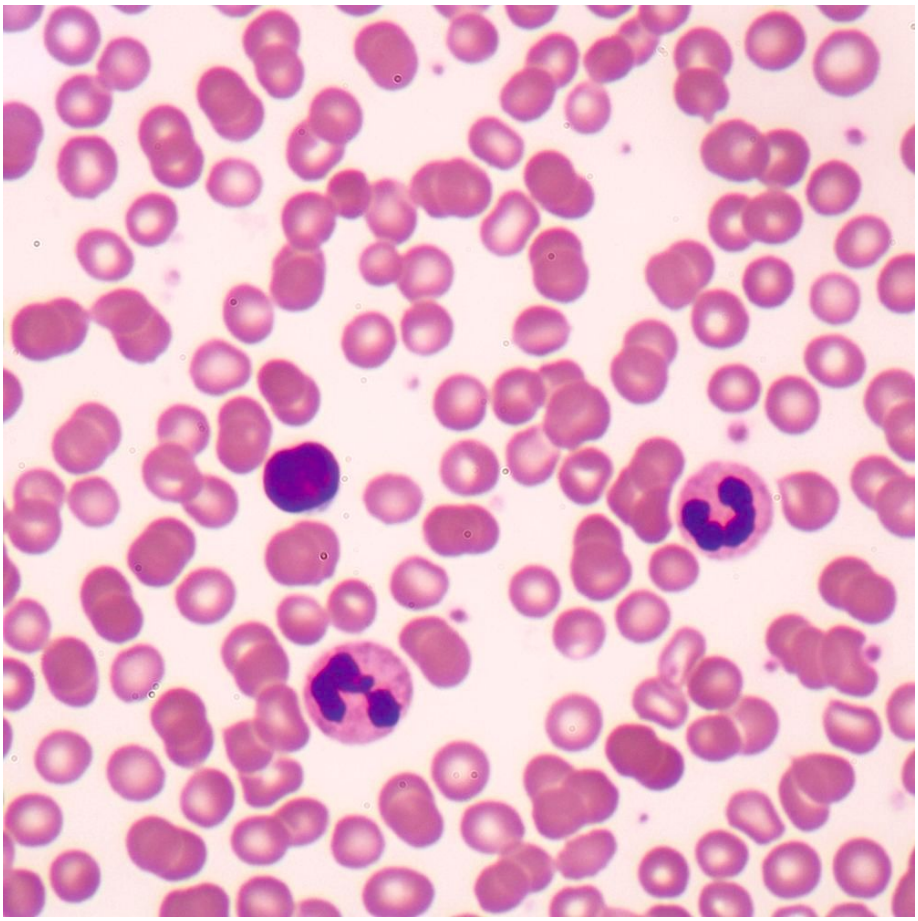
Blood Sample from Patient 2



Blood Sample from Patient 3



Blood Sample from Patient 4



Blood Sample from Patient 5