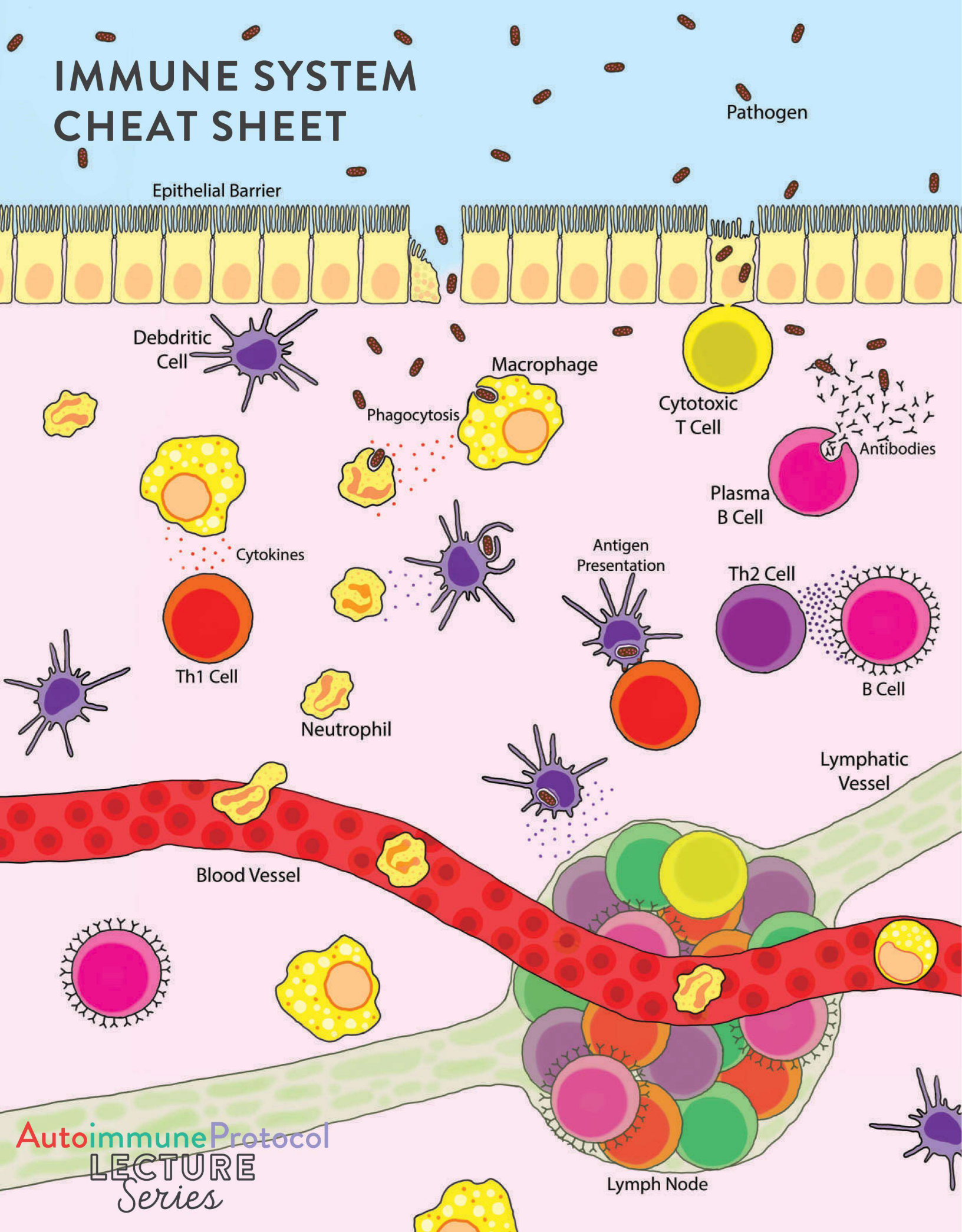
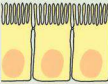














IMMUNE SYSTEM CHEAT SHEET
















The Immune System

Component		Function
Physical Barriers 		Skin, gut, lungs, saliva, etc. all provide a physical barrier between the inside of the body and the outside, which is difficult for pathogens to cross.
CELLULAR	Phagocytes ("Eater" Cells) Cells that engulf and destroy pathogens.	
	Macrophages 	Reside in connective tissues and organs of the body and act as sentinels. These "eater" cells produce cytokines that can kill pathogens, stimulate other phagocytes, and activate T cells and B cells. Responsible for antigen presentation to T cells and B cells.
	Dendritic Cells 	Reside in barrier tissues of the body and act as sentinels. These "eater" cells produce cytokines that can kill pathogens, stimulate other phagocytes, and activate T cells and B cells. Responsible for antigen presentation to T cells and B cells.
	Monocytes 	White blood cells with the ability to divide and mature into other immune cell types recruited to site of infection to replenish macrophages and dendritic cells.
	Granulocytes (Neutrophils, Eosinophils, Basophils) 	White blood cells recruited to site of infection that are particularly good "eater" cells. They rapidly engulf cells coated with antibodies or complement and secrete cytokines that can kill pathogens and stimulate more macrophages and dendritic cells. Eosinophils also have the ability to present antigens to T cells and B cells.
	Mast Cells 	Reside in most tissues surrounding blood vessels and nerves. When activated, they release histamine (a key component of allergic reactions), the anticoagulant heparin, and cytokines, which causes swelling and attracts more "eater" cells.
	Natural Killer Cells 	White blood cells recruited to site of infection specifically to destroy virally infected cells of the body, similar to cytotoxic T cells but respond more quickly. They also play a role in the adaptive immune system by maintaining immunologic memory, similar to memory T cells and memory B cells.
HUMORAL	Complement 	Includes 25 proteins produced by the liver that circulate in the blood. When activated, complement proteins bind to the surface of pathogens, sometimes directly killing the pathogen, but also attracting macrophages and neutrophils, and facilitating phagocytosis (engulfment of the pathogen) by these "eater" cells.
	Cytokines 	A huge collection of chemicals that act as messengers between the cells of the immune system. Some cytokines can directly kill pathogens.
	B Cells 	Lymphocytes produced in the bone marrow that circulate throughout the body via blood and lymphatic vessels, patrolling for antigens that match their antibodies/receptors. When B cells are activated, they divide rapidly, producing many plasma B cells and some memory B cells.
	plasma B cells 	Act as antibody factories, releasing thousands of antibodies into the blood or connective tissues.
memory B cells 	Patrol the body to mount a faster response upon subsequent infection with the same pathogen.	
Antibodies 	Secreted by plasma B cells. Antibodies bind to antigens, which can directly inactivate pathogens, stimulate release of complement proteins, and activate phagocytes, mast cells, and natural killer cells.	

INNATE IMMUNE SYSTEM

ADAPTIVE IMMUNE SYSTEM

Component	Function
T cells 	Lymphocytes that are produced in the bone marrow and mature in the thymus gland that circulate throughout the body via blood and lymphatic vessels, patrolling for antigens that match their receptors. T cells are broadly divided into two groups based on the presence of either CD4 or CD8 proteins in their cell membranes. T cells are considered naïve T cells until they are activated by cytokines and receptor binding (when they differentiate into one of the subtypes below).
cytotoxic T cells 	CD8+ T cells that specialize in attacking cells of the body infected by viruses and some bacteria. Cytotoxic T cells release chemicals called cytotoxins, which cause infected cells to die by cell suicide (a process called apoptosis).
helper T cells 	CD4+ T cells that are the major driving force and regulators of the adaptive immune defense. Which specific cytokines stimulate naïve T cells determine which type of helper T cell will be formed.
Th1 cells 	Release cytokines that recruit and stimulate macrophages and dendritic cells. Th1 cells also secrete cytokines that stimulate maturation of CD8+ naïve T cells into cytotoxic T cells.
Th2 cells 	Activate B cells which then divide rapidly to produce plasma B cells and memory B cells.
Th3 cells 	Protect the gut mucosa from nonpathogenic antigens (foreign substances other than viruses, bacteria, fungi, and parasites). Th3 cells act as immune modulators by suppressing Th1 and Th2 cells.
Th9 cells 	Similar to Th2 cells. Th9 cells activate B cells.
Th17 cells 	Similar to Th1 cells. Th17 cells stimulate inflammatory cells.
Th22 cells 	Similar to Th1 cells. Th22 cells stimulate inflammatory cells.
Tr1 cells 	Control the activation of memory T cells and suppress Th1- and Th2-mediated immune responses to pathogens, tumors, and “self.”
Tfh cells 	Regulate the formation of memory B cells and memory T cells.
regulatory T cells 	Suppress the activity of immune and inflammatory cells to shut down T cell-mediated immunity toward the end of an immune reaction. Regulatory T cells also suppress activation of dendritic cells and suppress the activity of any T cells that recognize self and therefore have the ability to attack healthy cells within the body.
memory T cells 	Similar to memory B cells with a longer life span. Memory T cells patrol the body to mount a faster response upon subsequent infection with the same pathogen.

CELLULAR

ADAPTIVE IMMUNE SYSTEM