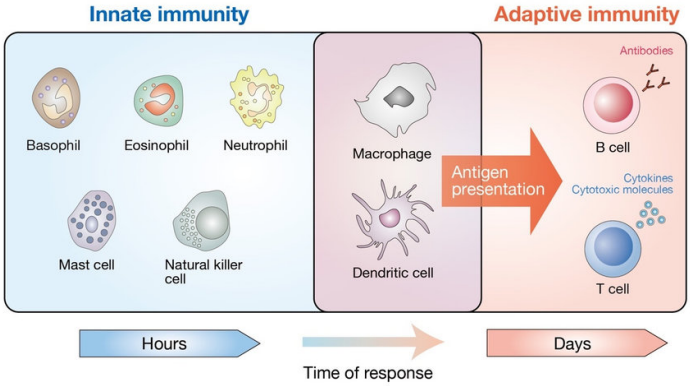
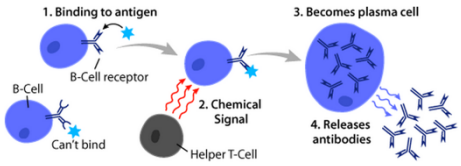
David Feldman's Immune Cell Crash Course



Innate	Adaptive
-Non-specific response -Recognizes general "danger signals" that all pathogens share in common -Starts as soon as pathogen enters your body -No immune memory developed (ie, no antibodies) -Includes anatomic barriers (skin, mucus, etc.), inflammation, phagocytosis, and cells that dump toxic chemicals to kill any pathogens nearby (neutrophils, basophils, and eosinophils), and cells that destroy bad host cells (NK cells)	-Pathogen/antigen specific response -Recognizes antigens of the pathogen that are being displayed by antigen presenting cells (macrophages and dendritic cells) -Takes several days to kick in (pathogen must first be detected by innate system, then antigens must be presented to an adaptive cell that recognizes that antigen, then that cell must expand its numbers) -B cells (antibody production) and T cells (both helper and cytotoxic T cells) -Allows for generation of immune memory since response is specific

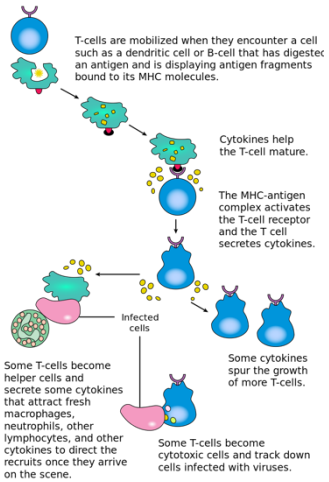
Type of Cell	Phase	Effect
Mast Cell/Basophils (Very different types of cells, but they do the same thing)	Innate	Come in contact with cells displaying damage, or pathogens, then they recognize general markers for these things. Then the mast cell/basophil "degranulates", releasing chemicals that cause inflammation. These are also the cells that causes us to have allergies, via their inflammatory effect
Natural Killer (NK)	Innate	If a cell is invaded by a virus, the cell will lose a marker on its surface. The NK cell recognizes the cell is missing a marker, it will secrete chemicals to kill the infected cell to prevent spread, and will also release chemicals that tell macrophages and T cells to be on red alert
Neutrophil	Innate	Detect signs of inflammation, then migrate to the site of inflammation. Once there, they look for markers of pathogens, and when they find those markers, they do a few things. First, they put out chemicals telling other cells to increase inflammation of the area, then they either phagocytize (eat) the pathogen and digest it, release super dangerous chemicals to kill everything around, or spit their own DNA onto the pathogen, where proteins on the DNA digest the pathogen
Macrophage	Innate/Antigen Presentation	When a neutrophil goes to work, it signals for macrophages to come on in and clean up. Neutrophils show up, and eat all the crud up (dead neutrophils (they die when they kill pathogens), dead and damaged cells, and pathogens). Once they eat the crud, they digest everything. If they ate a pathogen, they will take a piece of it (an "antigen") and display it on their surface to let T cells know that there was a pathogen, and then the T cells will each look at the antigen and one T cell will have a matching receptor for it
Dendritic Cell (DC)	Innate/Antigen Presentation	Basically they do the same thing as macrophages, but with a much bigger emphasis on antigen presentation. DCs are known as the ultimate Antigen Presenting Cell (APC). Without them, we essentially wouldn't be able to transition from innate to adaptive immune systems, because T cells would never be able to see the antigens of the pathogens, and therefore none would know that the pathogen they are prepared for is present
T Cell	Adaptive	T cells have a receptor (creatively named the T Cell Receptor) on their surface. Each T cell has a receptor that recognizes a different antigen. When APCs are presenting antigens, they go around searching for the T cell with the receptor that matches that specific antigen. Once a specific T cell recognizes the antigen, that T cell is activated and it will make a bunch of clones with the exact same TCR. There's basically two types of T cells, Helper T cells ($CD4^+$) and Cytotoxic/Killer T cells ($CD8^+$). Helper T's help B cells differentiate into plasma cells and memory cells, tell macrophages and neutrophils to show up, and help killer T cells work at peak efficiency. Killer T's simply recognize cells infected by viruses and destroy them.
B Cell	Adaptive	B cells have a surface receptor themselves (creatively named the B Cell Receptor). Like T cells, each B cell has a receptor that only recognizes a single antigen. When a naïve B cell's BCR finds the antigen (from a pathogen) it matches, that B cell becomes activated. Then a helper T cell will help it mature into either a plasma cell or a memory B cell. Plasma cells are essentially antibody factories, dumping millions of copies of antibodies that bind specifically to the pathogen that has the antigen that was detected out. The antibodies then bind to the pathogen to 1) mark that pathogen for destruction by other immune cells and/or 2) interfere with the pathogen's receptor that it uses for invading a cell to neutralize it. Memory B cells on the other hand are clones that can live for decades, and recognize the pathogen that they had previously experienced. They roam around the body searching for the same pathogen again, and if they find it, they very quickly become plasma cells to neutralize the pathogen much faster than if there was no memory cells. This is how we get immunity.

B Cell Activation



Final Note:
Keep in mind that the innate system kicks in right away, and is not specific for an individual pathogen, and that the adaptive system requires activation from a very specific signal and takes a few days to kick in, and you'll be fine! The innate system is required to activate the adaptive!

T Cell Activation



Overall Adaptive Immune System