



The Immune System: A Layman's Introduction

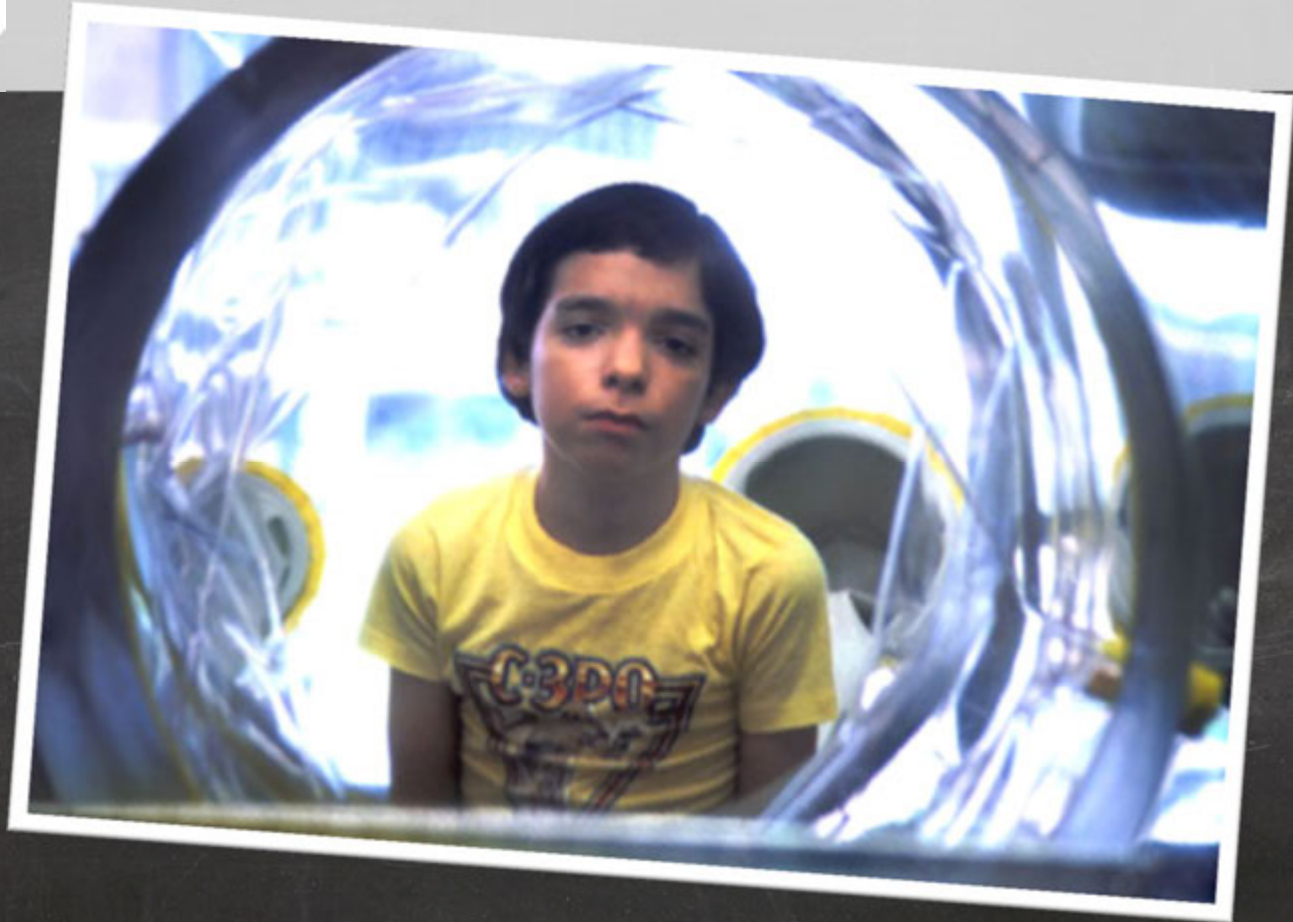
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THE IMMUNE SYSTEM: A LAYMAN'S INTRODUCTION

Is the Immune System Important?





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Cows Have More Bacterial Cells Than Cow Cells!

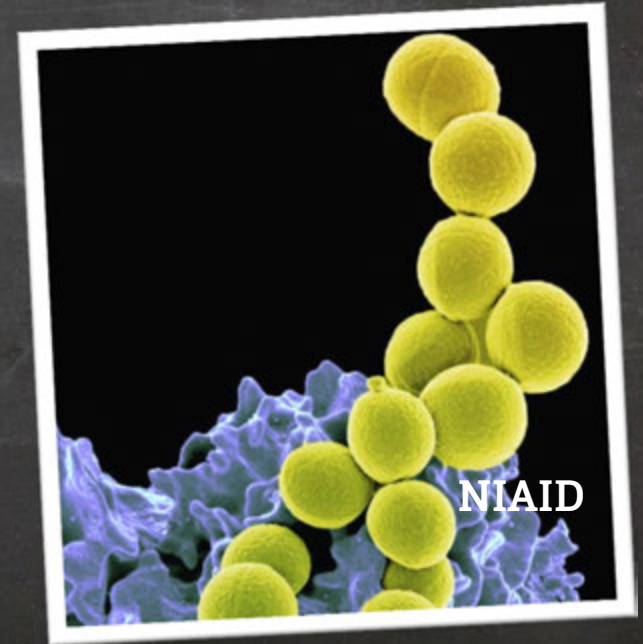




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Roles of the Immune System

- Monitors and manages the normal and pathogenic microflora found in and around the body
 - Bacteria
 - Viruses
 - Fungi
- Multicellular parasites
- Detects and clears rogue and compromised cells, tissue debris
- Many emerging regulatory roles





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Components of the Immune System

- Innate immunity
 - Relatively non-specific protective mechanisms
 - No “learning” necessary
 - Rapid or immediate responses
- Adaptive immunity
 - Specific to a unique antigen
 - Includes the antibody response, but also cell-mediated memory
 - Requires time to develop
- There is substantial cross-talk between these two arms



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Innate Immune System Components

- Skin, secretions (tears, mucus, gastric acid, even milk)
- Sentinel cells
 - Have receptors to sense “danger signals” associated with classes of pathogens
 - Signal to activate other innate or adaptive immune cells
 - Inflammation
- Phagocytic cells (“cell eaters”)
 - Pathogen clearance, antigen presentation
 - Some cells play both roles (macrophages, dendritic cells)
- Complement
 - Enzyme cascade that can directly kill pathogens and potentiates other innate responses
- Natural killer cells: clear infected or tumorous cells



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Key Innate Immune Cells: Macrophages

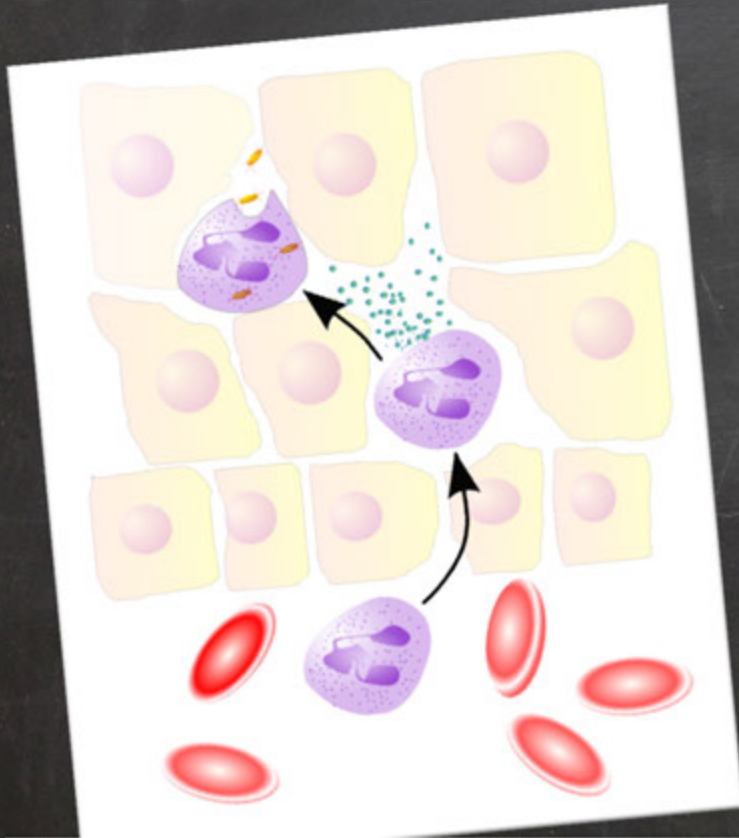
- Precursors (monocytes) are produced in bone marrow and circulate for several days, then migrate to tissues and differentiate into macrophages
- Key sentinel cells that can phagocytize and kill pathogens, present antigens to adaptive immune cells, and release cytokines to recruit other innate immune cells to the site





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Key Innate Immune Cells: Neutrophils



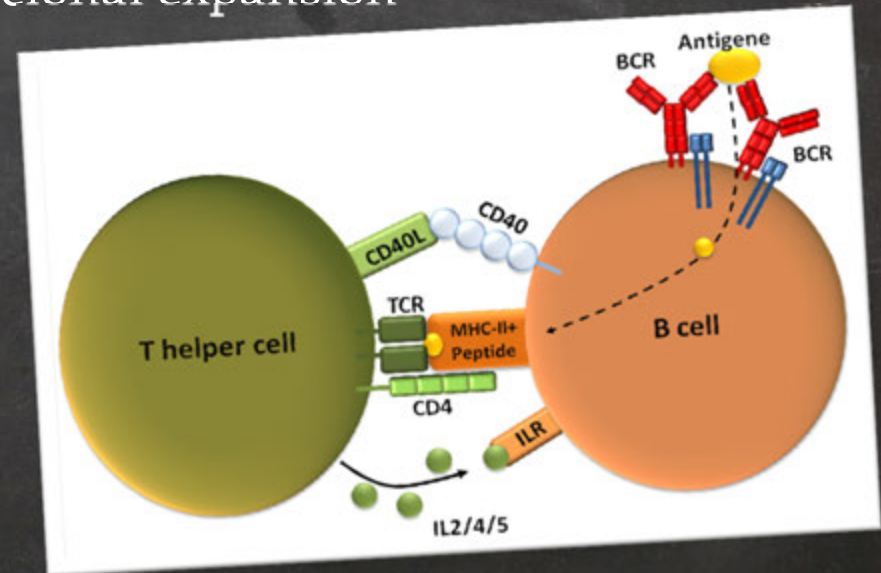
- Produced in bone marrow, circulate until recruited into tissue
- Release extracellular killing molecules and also phagocytize pathogens to kill intracellularly
- Oxidative burst
- Produce a variety of proteases to help them migrate through tissue and also “clear out” tissue



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Adaptive Immune System Components

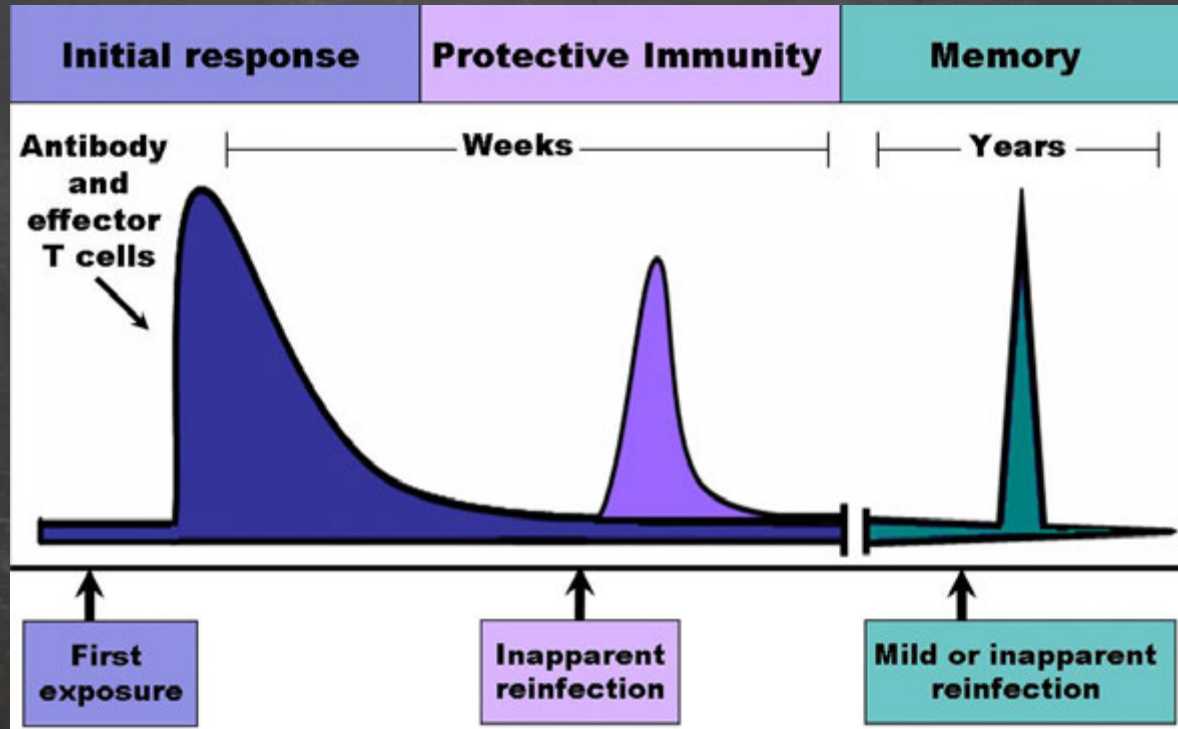
- B cells
 - Cells that produce the antibodies which provide for humoral immunity
 - Produce a wide variety of antibodies, and those that bind a pathogen-associated antigen are selected for clonal expansion
- T helper cells
 - Key to activation of selected B cells





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Adaptive Immunity Takes Time





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Adaptive Immune System Components

- Cytotoxic T cells
 - Similar to natural killer cells, they clear infected or tumorous cells
- Gamma delta T cells
 - Regulatory cells important for keeping immune response controlled
 - Especially important at mucosal surfaces (gut, lungs)
 - May play a key role in preventing pathogen responses to commensal microbes



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Changing View of Immunology

Traditional:
This cow
needs a
strong
immune
system



Today: Every cow
needs a strong
immune system





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Immune Cells are Integral to Many Physiological Processes

- Maintenance of gut tissue and commensal microbe homeostasis
- Regulation of nutrient metabolism
- Response to exercise
- Control of calving and uterine regression

And...

- Suppressing infections is an everyday job