Antibodies and Immunity
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Slide 1
A macrophage (a type of phagocytic cell) engulfs an invading cell.

Slide 2
The differences between innate immunity and adaptive immunity are summarized.

Slide 3
A phagocytic cell is any cell that engulfs particles (including other cells) by phagocytosis. A vesicle containing the phagocytosed particle then fuses with a lysosome, exposing the particle to enzymes in the lysosome, breaking the particle into harmless pieces.

Slide 4
The lymphatic system consists of a network of lymphatic vessels running alongside blood vessels. The lymphatic vessels collect fluid that leaves the blood stream at the capillaries. This fluid (called lymph) can include pathogens such as viri and bacteria. Lymph nodes scattered throughout the network of lymphatic vessels house tissue that collects these pathogens and exposes them to immune cells that take steps to destroy the pathogens.

Slide 5
The skin is a physical barrier against entry of pathogens into the body. When the skin is broken by injury, pathogens enter the body. Recognition of pathogens by cells of the immune system triggers an inflammation response. Phagocytic cells already on hand engulf some of the pathogens. Immune cells release chemical signals that cause other immune-system cells to leave the blood stream and help in the destruction of the pathogens at the site of the injury.

Side 6
Foreign cells that enter a vertebrate's body contain particles that can be recognized by specialized proteins produced by cells of the vertebrate immune system. These recognizable particles are called antigens. There are two major kinds of immune-system cells that are able to recognize antigens:

- B cells produce roughly Y-shaped antibodies that can recognize antigens. Antibodies can remain on the surface of some B cells, where they can operate in the cell-mediated immune response, or they can be released by B cells into the plasma, where they operate in the humoral immune response.
- T cells produce roughly linear antigen receptors that operate similarly to antibodies. However, T-cell antigen receptors remain on the surface of T cells instead of being released into the plasma.

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An antibody is a protein consisting of constant regions (near the cell surface) and variable regions (at the tips). The constant regions are the same sequences of amino acids in all antibodies. The variable regions differ from one type of antibody to the next. The variable regions are the parts of an antibody that are able to recognize and bind to an antigen of a corresponding shape. There are millions of different kinds of antibodies produced within a vertebrate's body, each able to recognize a specific antigen.

Slide 8
An epitope is the specific part of a particle that is able to bind to a specific antibody. An epitope can bind to only antibodies having the correct shape, much like a key is able to fit only certain locks. This is the basis of the specificity of adaptive immunity in vertebrates.

Slide 9
Though a T-cell antigen receptor has a different shape compared to an antibody, it also contains constant regions and variable regions. Therefore, T-cell antigen receptors also come in a huge variety of versions, each with specific recognition of an antigen

Slide 10
Antigen presenting cells are cells that respond to being infected by an antigen by forming complexes of antigens bound to antigen receptors. These complexes are then placed in the plasma membrane of the antigen presenting cells, exposing the antigens to T cells having the corresponding type of antigen receptors. Recognition by the T cells leads to destruction of the antigens.

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B cells are produced from stem cells. All of the stem cells have the same DNA, including the genes coding for antibodies. Before a stem cell develops into a B cell, the DNA within the antibody gene is randomly edited by cutting out sections of the DNA. This allows the same kind of stem cells to produce millions of different kinds of B cells, each with its own DNA sequence making up the antibody gene. Therefore, each different kind of B cell produces a different kind of antibody and only that kind of antibody. If the cell undergoes mitosis, it will produce other B cells that can produce only that same kind of antibody.

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If a B cell detects an antigen, that B cell will be spurred into replicating itself. The resulting group of identical B cells (called a clone) leads to two populations of cells capable of making that particular antibody. One population contains cells known as memory cells, that remain in the body ready to reproduce rapidly if the same kind of antigen invades the body in the future. The second population contains cells known as plasma cells, which specialize in releasing their antibodies into the plasma, providing long-term protection against that type of antigen.

Slide 13
A T cell that binds to an antigen being presented to it by an antigen presenting cell releases chemical signals, called cytokines, that stimulate B cells to release antibodies (a humoral response) and that stimulate T cells to proliferate (a cell-mediated response).

Slide 14
A cytotoxic T cell can release proteins, called perforins, that embed into the plasma membrane of an infected cell. The arrangement of the perforins forms holes in the infected cell, which quickly kills the cell, preventing it from making copies of the invading antigen.

Slide 15
A helper T cell becomes activated by an antigen presenting cell. The activated helper T cell then releases cytokines that stimulate appropriate B cells into producing plasma cells and memory cells. This prepares the body against future invasion by he same antigen.

Slide 16
A virus can be neutralized by being bound by several antibodies. Opsonization is the process in which an antibody-bound pathogen is prepared (by changing its surface charges) for easier phagocytosis by a phagocytic cell. Antibodies are also able to activate a protein complex, called complement, that forms pores in an invading cell's surface, thereby killing the invading cell.

Slide 17
An allergy is a hypersensitivity to an antigen (in this case called an allergen) that normally would not be harmful to the individual. Otherwise, it works the same as the immune response for any antigen.