

**BENG 100 Frontiers of Biomedical Engineering**  
**Professor Mark Saltzman**

**Chapter 15**

**SUMMARY**

- One of the most important advances in medical science over the past 200 years is the use of vaccines to prevent infectious disease.
- The immune system responds to the presence of many foreign antigens by producing specific antibodies. Antibodies vary in specificity as well as class; the ability to make a range of antibodies is important in health and creates many opportunities in biotechnology.
- A variety of approaches to vaccine production have been developed, including the use of attenuated or killed viruses, protein subunits, engineered viruses, and DNA as the vaccine component.
- Despite important progress in disease prevention, there is still much to learn about how to make vaccines and how the immune system responds to different vaccine preparations.

**KEY CONCEPTS AND DEFINITIONS**

antibodies – a large Y-shaped protein that is used in the immune system to identify and counteract invaders such as viruses, bacteria, or transplanted organ by binding to the antigen.

antigen – a substance introduced into the body that can stimulate the production of antibodies.

antiserum – a serum composed of antibodies that has been inoculated into an animal for use in a second animal to provide immunity against a particular disease.

ascitic tumors – a tumor caused by the accumulation of fluid in the peritoneal cavity.

attenuated – retaining the immunological properties, in reference to a virus, without the diseasecausing characteristics.

B cells – lymphocytes that develop in the bone marrow that produce antibodies against specific antigens. Also called B lymphocytes.

cirrhosis – a disease of the liver where healthy cells are replaced by scar tissue, leading to the loss of liver function.

cysteine – a naturally occurring amino-acid that contains a thiol group

dimeric – consisting of two similar molecules, or monomers, that have been linked together.

effector region – a position where a small molecule is bound to a macromolecule in an antibody.

enterovirus – a virus that infects through the intestinal tract and so is primarily contracted by the fecal-oral route.

glycoprotein – a group of macromolecules that all contain a protein connected to a carbohydrate.

glycosylation – the an enzyme directed addition of a glycosyl group to a protein to form a glycoprotein.

half-life – the time required for a quantity to decay to exactly half of the initial amount present.

hybridomas – cells that produce large amounts of specific antibodies, formed by the fusion of a normal cell with a cancer cell.

immune system – a system of the body made up of cells and tissues that protects the body from foreign invaders through destruction and removal.

immortalized cell line – cells that have been altered to grow indefinitely under proper culture conditions, unlike primary and secondary cells.

immunosuppressive – capable of reducing the normal function of the immune system.

immunotoxin therapy – treatment method for cancer and viruses that uses substances capable of altering the normal function of the immune system to protect against toxic compounds.

immunotoxins – chemicals that can cause the malfunction of the immune system by destroying specific cells.

lymphocytes – a particular type of white blood cell in charge of fighting infection and disease, including natural killer cells, B cells and T cells.

monoclonal antibody – antibodies that have been derived from the same clone.

monomers – a molecule that has the ability to combine with other molecules to form a polymer.

myeloma cells – cancer cells found in bone marrow that produce antibodies.

parenteral – a method of entering the body other than through the oral cavity.

pathogens – a disease-producing agent.

pentameric – consisting of five identical molecules, or monomers, that have been linked together.

pharmacokinetics – the process by which a drug enters the human body.

plasma cell – a B cell that has matured into an antibody-producing cell.

polymerization – the process of forming a polymer.

recombinant DNA – a DNA molecule that has been created from the insertion of one or more gene segments resulting in a new genetic sequence.

secretory piece – a polypeptide chain with the ability to bind to secretory IgA molecules.

sera – the liquid portion of blood after all clotting factors have been removed.

titers – of high concentration.

trimeric – consisting of three identical molecules, or monomers, that have been linked together.

vaccines – a preparation of a pathogen that has been weakened or killed with the ability to stimulate antibody production when administered to the human body.

## QUESTIONS

1. Design an experiment to determine whether or not a vaccine has been effective.
2. Explain the difference between a subunit vaccine and a DNA vaccine.